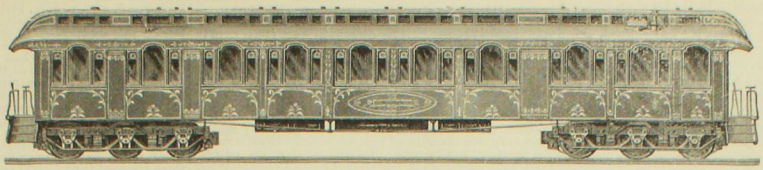
THE NATIONAL CAR-BUILDER.



DEVOTED TO THE INTERESTS OF RAILWAY ROLLING STOCK.

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What Master Mechanics are Doing.

MR. TILTON, of the Chicago and Northwestern railway, has got out the drawings for an iron truck which he intends making standard for his 20-ton freight cars. It resembles very closely the one recommended for the standard by the Master Car-Builders' Association.

MR. E. B. WALL, of the Pittsburgh, Cincinnati & St. Louis road, intends to try all of the vertical plane couplers which were approved at Buffalo. He has ordered some of each kind which were not already in use on the road, and will test them thoroughly.

THE Louisville, New Orleans & Texas Railway Company contemplate building new machine shops this year. During the last year they added seventeen new locomotives to their equipment, from the Rogers and Schenectady locomotive works.

THE two Fontaine locomotives, of controversial memory, have been rebuilt into the form of ordinary eight-wheel engines by the New York Locomotive Works, for the Wheeling & Lake Erie Railway, and they are now running on that road.

NO locomotives have been built by the Grand Trunk Railway Company during the last year. This is something unusual, for the company do not buy any locomotives, the fine shops at Montreal being sufficient to provide all the machinery needed over the whole system.

MR. JOHN S. COOK, Master Mechanic of the Georgia Railroad, informs us that they are very busy in their shops at Augusta, Ga., preparing their machinery for the change of gauge of the road, which is going to be carried out next June. The gauge at present is 5 feet, and it will be changed to the Pennsylvania gauge of 4 feet 9 inches.

WE learn from Mr. John Hickey, Master Mechanic of the Milwaukee, West Shore & Western Railway, that they have carried on a great many experiments during the last year to determine the most economical form of spark arrester. The result is that they have adopted the extension smoke-box. They built a new locomotive in their shop at Kaukauna, Wis.

IN the course of the year 1885, the Louisville & Nashville Railroad Company built six of their standard locomotives in the shops at Louisville, Ky. The engines are of the kind illustrated in the NATIONAL CAR-BUILDER, March, 1883. The engines have cylinders 18 × 24 inches, and a boiler 54 inches diameter at smallest ring, with 200 two-inch tubes.

MR. WILLIAM WILSON, Superintendent of Machinery of the Chicago, Alton & St. Louis Railroad, built three eight-wheel locomotives in the shops at Bloomington last year. A few of the particulars are, cylinders 17 × 24, drivers 64 inches diameter, driving wheel base 8 feet 8 inches, total wheel base 23 feet 1½ inches, weight of engine in working order 84,000 pounds, weight on drivers 56,000 pounds.

IN the course of a letter to one of the editors of this paper, Mr. R. D. Wade, Superintendent of Motive power of the Richmond & Danville Railroad, says: Our new consolidation engines have not been in service long enough to enable us to determine exactly what they will do, but so far, we are well pleased with them. They are free steamers, smart, ride wonderfully well, and take curves easier than any engine I was ever on. In fact, with eyes shut you can't tell whether you are on a curve or tangent. They promise to be very economical in fuel.

DURING the month of October, the Cleveland, Columbus, Cincinnati & Indianapolis Railway had 215 of their whole number of 224 locomotives in service. That was 96 per cent., and was an unusually large proportion of the engines to be in service during one month. They averaged 3,453 miles per engine, and ran 29.46 miles to the ton of coal, the passenger engines using 53 pounds, and the freight engines 92 pounds per train mile. The passenger trains averaged 4.1 cars, the freight trains 24.1 cars.

THE Chicago, Rock Island & Pacific Railway Company have built 19 new locomotives at their shops in Chicago during the past year, 13 passenger and 6 mogul engines. The passenger engines have cylinders 17 × 24 inches, driving wheels 61½ inch centers, straight boiler 54 inches diameter at smallest ring, fire-box 65 × 34 inches, with arched crown sheet supported by radial stays. Weight of engine 40¼ tons. The moguls have cylinders 18 × 24 inches, with 51½ inches wheel centers, the boiler being the same as that for the passenger engines.

IN the course of last year, Mr. F. A. Chase, Master Mechanic of the Kansas City, St. Joseph & Council Bluffs Railroad, built a Chicago, Burlington & Quincy standard Class A engine for the Hannibal & St. Joseph Railroad. The engine has cylinders 18 × 24 inches, driving wheels 57 inches centers, with 4-inch Midvale steel tires. Boiler shell is 51 inches diameter at smallest ring, and has 191 2-inch tubes. The fire-box is 72 inches long. Boiler and fire-box are both of steel. The engine is fitted with driver air brake, sight-feed cylinder lubricators and other approved attachments.

FOR many years the Illinois Central Railroad Company have followed systematic methods of purifying the water used in their locomotive boilers, but the practice has produced very indifferent results. Lately they have gone into eliminating scale formers at the fountain head by providing surface water. They have done a great deal of work during the past summer in getting soft water to take the place of wells of known bad character, and decided improvement has resulted. Mr. Schlacks, who is ardently in favor of soft water, thinks that by the time the work projected for next summer is completed, they will be able to get along without their purifying apparatus, which is troublesome and expensive to care for.

WHEN Mr. Johann, the well-known master mechanic, first took charge of the machinery of the Wabash Railway, there were a great many different forms of engines on the road with the same size of cylinder, yet with cylinders of different patterns. He at once set about the task of making a cylinder of one pattern fit any engine that took the size. He established standards for each size, and when an engine had to get new cylinders he made the frame in front of the forward driving-wheels standard, offsetting the connection with the back frames, if necessary, to make the front part fit on. Before he left the road all the 16×24-inch cylinders in use were interchangeable. All other parts were brought down to interchangeable shape, as far as practicable. Only one form of pilot was used on the whole road.

MR. N. J. PARADISE, master mechanic of the Hannibal & St. Joseph Railroad, has recently built a new eight-wheel locomotive in the company's shops at Hannibal, Mo. The engine was built to equalize the work of the shop, and to keep the tools employed. The cylinders are 18 × 24 inches, and driving-wheel centres 57 inches. The boiler is of the wagon-top type, raised 14 inches. The fire-box is 72 inches long by 34 inches wide, and is made of steel. There are 198 tubes 2 inches diameter in the boiler, and they are 10 feet 11 inches long. In working order the engine weighs 81,000 pounds, of which 53,270 pounds are on the drivers. The engine is fitted with a driver air-brake, and all the most approved appliances for promoting economy in operating, among which may be mentioned the Nathan lubricators and injectors.

Origin of the Name "Consolidation" Locomotive.

A correspondent says: "I would like to know exactly what is consolidated in the 'consolidation' locomotive. The names eight-wheeler, ten-wheeler, Mogul, Forney, and so on, are intelligible, but I can not perceive any thing applicable about the word consolidation to the engine that bears that name." As we have heard this question discussed several times, it may be desirable to explain the origin of the name, which was not suggested by any thing about the construction of the locomotive. The first consolidation engine was designed by Mr. Alexander Mitchell, then master mechanic of the Lehigh & Mahanoy Railroad. Just about the time the engine was completed, the Lehigh & Mahanoy Railroad was consolidated with the Lehigh Valley Railroad, and the name consolidation was given the engine to honor the event.

THE relative merits of chilled iron and steel-tired wheels is to be made the subject of a test on the Boston & Providence. A car will be fitted, one truck with iron and the other with steel-tired wheels. The car will run 140 miles and make thirty stops a day. The wear is to be carefully noted and accurately recorded.

SHOP NOTES.

Editorial Correspondence.

CHICAGO, BURLINGTON & QUINCY SHOPS, AT AURORA, ILL.

Work is rather slack at these shops at present. The fine shops at Burlington naturally monopolize the locomotive and machine work, and the company finds at existing low prices of cars outside builders can do the new work cheaper than they can do it in the car shops at Aurora. So these are doing nothing but repair work and not very much of that. They have been making some improvements in the car shops lately, the most important item being the putting in of a new Harris-Corliss engine of 200 h. p. They are building a new paint house and making changes on their sand-drying house, that will provide the means of raising the dried sand by means of carriers fastened on an endless chain, and run it by gravity into the sand boxes of the engines. When the paint house is completed it is the intention to put in machinery for grinding and mixing the greater part of the paint used in the works.

The busiest part of the works at present is the pattern shop, which has about double the ordinary force getting out new patterns.

There is nothing except repair work going on in the machine shops. They use a small double cylinder portable engine for doing odd jobs around the shop that power cannot be applied to otherwise conveniently. It was applying power to bore out a pair of cylinders the day we were there. Anything a flexible shaft can operate is supplied with power from this engine. They have lately put extension smoke-boxes on two engines, which are the first belonging to the road so equipped. One of them is the engine used to pull the General Manager's car. They are very well satisfied with the performance of the engines since the change was made.

The most interesting thing that we saw about these shops is the laboratory. This has grown up quietly but rapidly in the last four years, till it is now the best laboratory connected with railroad shops in the country. It is provided with the best appliances for making physical and chemical tests of material, and has a staff of experts perfectly competent to carry on all the scientific investigations necessary in ascertaining the strength and character of supplies furnished to the road. The quality of no material is accepted as satisfactory without question, and it is surprising the quantity of "first-class" material that is rejected on physical test and chemical analysis. The way this practice of making systematic tests works, is this: A sample of goods is furnished, and an analysis made which indicates the material to be defective. It is taken back by the dealer without any question, and the probability is that it is sent to some road that does not follow the practice of testing its material. The tests under way included all kinds of oils, paints, soap, varnish, all kinds of metal, material for flags, etc. An examination of a series of steel tests and their comparison with analyses made by various well known chemists, showed that the work in this line done here is of high scientific value.

We were particularly interested in a series of analyses made by Mr. Brown, the chief chemist, to ascertain the percentage of free acid in tallow received. It is the free acid present in tallow or oil used as a lubricant which does the destructive work, so familiar to railroad men, of eating away the castings, and this company does not accept tallow containing more than one per cent. of free acid. We saw records of specimens analyzed that contained as much as 45 per cent. of free acid, and from 5 to 10 per cent. was common. It is not surprising with this condition of affairs that copper joints and castings get corroded badly when such stuff is put into a hot steam chest. Besides being destructive to metal, tallow containing a high percentage of free acid is a poor lubricant, for the acid has no lubricating property. Valve oil is generally a mixture of mineral oil and tallow, and it is important for users to know that the tallow used in this mixture is fairly free from acid, otherwise it imparts the dangerous element to the valve oil.

WABASH ST. LOUIS & PACIFIC RAILWAY SHOPS, TOLEDO, O.

Great activity has prevailed around these shops lately. It is believed that the Wabash shops, at Toledo, are now

the best railroad car shops in Ohio since they were renovated. A new master mechanic's office has been built, a new store room has been added to the car shop, and new skylights put in paint, coach and machine shops. The machinery has been all overhauled and painted, and a general cleaning up of all old truck has been thoroughly carried out. The appearance of things round the shops lead those connected with them to believe that the prospects of the Wabash are brightening.

In the passenger car shops eight coaches have been thoroughly overhauled, painted and varnished and turned out in first-class style during the last six weeks. They have now on the trestles two new chair cars, which will be very handsome additions to the passenger equipment when completed. They have also got in five coaches undergoing heavy repairs.

CHICAGO, ALTON & ST. LOUIS SHOPS AT BLOOMINGTON, ILL.

The method of heating these shops is peculiar. A large nest of pipe radiators, through which steam circulates, is inclosed in a case connected by a large pipe with a Sturtevant blower. The blower draws air that has to pass over the pipes forming the radiators, where it gets heated. From the blower this hot air is forced through pipes under the floor of the shop, and it passes out by many openings at various points. By this arrangement the heat is particularly well distributed to all parts of the shop. The exhaust steam from the shop engine is passed through the radiator pipes and serves to warm the shop in mild weather, but when it is very cold steam from heating boilers is used also.

They follow an unusual practice on this road in taking up the lost motion between cross-heads and guides. The usual way is to line the upper guides with thin pieces on top of the blocks that can be taken out so that the guides may be closed to take up the lost motion due to wear of the cross-head. Here they always keep the blocks solid, and when lost motion has to be taken up they take out the cross-head and put in another of standard size, which fits guides and piston. The cross-head that has been removed is then planed down to admit of a gib that brings it up to the standard. The cross-heads generally used are cast iron, with a wrought iron bar running through each wing and riveted at the ends. This invariably holds in case of the cross-head breaking. The cross-heads, like many more of the parts handled in this shop, are got out very systematically. Ten are placed upon the planer at once, the end cross-head having a hardened steel template bolted behind it, to which the tool must work. The cross-heads used on the switching engines are the kind that work on a single guide. They are made of steel and have the wrist-pin cast solid on one wing, a movable plate securing the other side. Mr. Wilson says this makes a very strong and cheap underhung cross-head. This is the only cross-head we know of that has a solid wrist-pin and takes in a solid front end of main rod.

The transfer-table connected with the machine shop struck us as being the most conveniently operated table we had seen. An endless wire cable operated from the shafting in the shop traverses the whole length of the transfer-pit, running in an underground frame and embracing a wheel fastened to a shaft upon the transfer-table. The power supplied to this shaft can be used to traverse the table or to operate a winch for pulling engines or cars with material on or off the table. Mr. Wilson says that snow has very little effect on the working of this arrangement, which gives it a strong recommendation for many roads.

The iron foundry, brass foundry and pattern shop are all grouped together near the car shops, and are models of order and cleanliness. Draft for the brass foundry furnaces is got by running a flue into the smoke-stack of the planing mill boiler, the draft being caused by induction. There is a fine new fire-proof pattern house detached from the other buildings.

Mr. Townsend, master car builder, is not doing much in his side of the establishment, there being no new car work on hand. He is cleaning up passenger cars and rebuilding some freight cars.

New Wootten Locomotive.

We learn by a letter from Mr. J. E. Wootten, General Manager of the Philadelphia & Reading Railroad, that they have built three unusually heavy locomotives during the last year in the company's shops at Reading. The following are a few of the leading dimensions. It will be observed that the boilers are unusually large, with no less than 336 tubes that provide 1,212 square feet of heating surface.

Cylinders	21 × 22 in.
Diameter of driving wheels	68½ in.
" " truck "	33 in.
Wheel base	21 ft. 1 in.
Diameter of boiler	58⅝ in.
Tubes	336
Length of tubes	9 ft. 2¾ in.
Diameter of tubes outside	1⅝ in.
Length of fire-box, inside	9 ft. 6 in.
Width " "	8 ft. ⅜ in.
Grate area	76 sq. ft.
Heating surface of tubes	1,212 "
" " " fire-box	205 "
" " " total	1,417 "
Weight on driving wheels	71,050 lbs.
Total weight	103,850 "

Master Car-Builders' Club.

The regular monthly meeting of the Club was held at the rooms, 113 Liberty street, New York, on Thursday evening, Dec. 13, Mr. Leandes Garey, the president, occupying the chair. The subjects for discussion were announced to be:

WHEELS AND AXLES.

The President: I think the railroad men, as a rule, would like to hear some talk from the wheel manufacturers. They can find fault; that is one of the easiest things there is to do, and wheel men are the men they find fault with, and if the wheel men will take up the subject and enlighten the railroad men somewhat I think it would be beneficial to all parties. I would say that my impression has been for many years that the wheel manufacturers are more at fault in not manufacturing up to the highest standard possible from the materials they use. Now a poor cook will spoil the best materials furnished for a dinner. I would like to ask the wheel men if they do the best they can in the manufacture and in the use of the materials they can get hold of?

Mr. W. W. Lobdell, of the Lobdell Car Wheel Co.: I think we know how to make them out of good materials, at all events, we always aim to make the best article out of the best materials we can control. I do not, however, agree that it is much the fault of the wheel manufacturers. I think it is the fault of the men who use the wheels, as they often patronize those who make a poor article, and do not discriminate between those who make good and poor wheels. I do not want to measure my corn in anybody else's bushel, neither do I want anybody else to measure his corn in my bushel. I am willing that the character and the reputation of our wheels should stand on the service they render to railroads; but I am free to say that in many instances, we do not get a remunerative price for the article we furnish when we come in competition with some wheel makers who furnish a wheel at a very low figure. Rather than have an old customer taken away from us, we will make wheels at cost, and do do it sometimes on that account. There should be no reason why wheel makers should not know the character of the wheels they make. Unfortunately, there are a great many people in this country who make wheels and who have no practical knowledge of the business. They are dependent upon the skill of a foreman, of a manager or a superintendent, and if I was a railroad man I should discriminate, and not buy my wheels of persons who have not a practical knowledge of the business.

Mr R. C. Blackall: We have had considerable to say to wheel men, and if we choose to talk as having charge of railroads, we could say much on the wheel question, but we pecked at them so much we found out at one of our discussions that the wheelmakers all had a different sized chill. None of them used the same chill. I have also noticed that we appear to be getting a little better quality wheel now than a while ago. It may be owing to different shape of the tread, or something of that nature. I would like to ask what makes the wheel better? We are buying wheel about as cheap to-day as a year or two ago, but the wheels are certainly doing as good service to-day. They have either added something to the weight of the wheel or slightly modified it in some particular which is giving us a better wheel.

The President: I heard not long since that there were certain parties in the State of New York who were manufacturing what they thought the best wheel in the country. Now they think the wheels are not as good as they should be. I am not going to call any names, but it is a prominent wheel maker, which would lead me to think that there were some parties who are not making as good a wheel to-day as formerly. While I agree with Mr. Blackall in reference to the quality of the wheels that are made to-day, as a rule I think they are far better than they were a few years ago, in many respects.

Mr. Lobdell: I do not know how it may apply on certain roads. Bush & Lobdell used to make wheels twenty-five years ago that would compare in quality with any wheels that are made to-day. They performed as good service as any chilled car wheel to-day can give. Some manufacturers use anthracite iron in making their wheels, and their experience may have taught them that this was not a good material to employ, and possibly they have stopped using it and thus make a better wheel. There is no doubt wheels are too light. As the cars have been increased in weight the wheels have not been increased. I think the 33-inch wheel for freight cars should not weigh less than 560 pounds, and it would be better if it weighed 600 pounds. Passenger car wheels should be at least 600 pounds, to enable the wheel maker to produce the best wheel with the materials at hand.

The President: Some few years ago when we first began to increase the carrying capacity of our cars, and it was evident that we were to carry about 20 tons, which is double the carrying capacity of our freight cars then, I called the wheel makers together and stated the case to them and asked their opinion as to the heft of the wheel, whether it should not be increased, and with very few exceptions—very few indeed—they were all in favor of the wheel as it was—that it was heavy enough. Not being a wheel maker, I began to think I was wrong in my calculations, but I found that since that time they are gradually working up to a heavy wheel to do the service required. They were very slow to move, but having once started I find they are running ahead very fast.

Mr. Lobdell: I would like to state a fact. Several years ago, when the Union Freight Line, or Pennsylvania road, and the Empire Line were controlled by Mr. Houston, the Lobdell Car Wheel Co. made all their wheels. They paid $1 a wheel over the customary price for extra selection, extra weight wheel, and I am satisfied that they made money by it. At the time the Lobdell Company made all or nearly all of the wheels used on the P., W. & B. road, Mr. Felton and Mr. Hinckley pursued the same policy. They paid extra price for extra selected and extra weight wheel, and I think I have in my pocket the report of the mileage of that road for a certain length of time, which I am willing should be compared with the mileage report of wheels on any road in the United States. It reads as follows:

The following statement is condensed from the mileage reports furnished by the P., W. & B. Railroad Company, of wheels made by the Lobdell Car Wheel Co. and removed between June, 1876, when the record commenced, and July, 1881, when the railroad company ceased to furnish the reports. The reports include all wheels removed from passenger, baggage and express cars. From June, 1876, to March, 1877, inclusive, no record was kept of the cause of removal. During this time 92 wheels were taken out which had made an average of 46,385 miles. From April, 1877, to July, 1881, inclusive, the cause of removal was given in the reports furnished by that road. During this time, 1,072 wheels were removed from all causes. Of these there were 702 wheels worn out, including 82 slid wheels which had made over 50,000 miles before being flattened, some of the latter having made 100,000 miles and over, before removal. Two pairs cracked in the braces. Those are all the cracked braces reported out of that 1,072 wheels that had made 62,474 and 120,240 miles respectively before being repaired. These were the only wheels out of the whole lot removed for this cause. There were 248 wheels that were slid before making 50,000 miles, and the remainder, 122 wheels, represents those removed from freight service before being worn out. The average mileage of the 702 wheels in the worn out class was 74,664 miles; that of the 248 wheels in the slid class (including only those that were under 50,000 miles) was 16,403 miles. The average mileage of the 122 wheels removed to freight service before being worn out was 37,457 miles, and as these were mostly removed because of defects in the axles, undoubtedly many of them were perfectly good when put under freight cars, and must have given many more miles in that service. The average mileage of the whole 1,072 wheels, including those that were slid, was 60,462 miles, without allowing any credit for the extra mileage made by those under freight cars. It may be noted that no wheels were reported removed for sharp flanges. After this time the Pennsylvania road came into possession, and they did not make any returns of the mileage. The wheels weighed 575 pounds each. They were extra heavy wheels, chilled extra deep, and were extra good in every other respect. I think the air brake was used on the cars. I will allude to one fact which has a bearing on the cracking of wheels. The form of the wheels which were used on both the Empire Line and the P., W. & B. road was that which has a flange around the inside of and opposite to the flange of the wheel, which adds materially to the strength of the rim, and prevents the expansion of the wheel when heated by the application of the brakes, which, in my opinion, is the cause of the cracking of the braces of a great many wheels. It also enables us to give a better chill to the roof of the flange.

The President: I would ask the wheel men what is the weight of the 33-inch wheels as now manufactured?

Mr. Lobdell: It depends upon the specification given by the railroad company. I should say from 500 to 625. I do not know of any as light as 500 pounds used on passenger cars. Railroad companies make contracts with car builders to make cars, and they do not specify the weight of the wheel to be used. The car-builder, therefore, puts under as light a wheel as he can get the railroad company to use. I think the railroad company should specify the weight of the wheel.

Mr. Blackall: Do you give the same guarantee?

Mr. Lobdell: We don't always do that. If we know the service and think the wheel too light we will not give the guarantee. We can make a 500-pound wheel that we are pretty certain will not break, but we will not warrant it to last as long as the 550-pound wheel, all things being equal.

The President: I heard a very prominent general superintendent of a railroad say not long since, that the road by which he was employed could not afford to use steel-tired wheels, and if he could get good cast-iron chilled wheels, as good as he thought they made years ago, he thought they were not only cheaper for the road, but as safe for the passengers. Do steel wheel men agree to that?

Mr. H. A. Little: In answer to that, I will say that some months ago I went in to see the general manager of a prominent line, and as most of you know, I am an advocate of steel-tired wheels. I showed my hand, and he told me at once that cast-iron wheels were good enough for anybody, and finally gave me to understand it was no use to talk steel-tired wheels. On the evening when I left the city I found that his private car was on the train, and it was fitted with steel-tired wheels. If cast-iron wheels are good enough for passengers who pay for their ride, why are they not just as good for those who ride free?

Mr. W. W. Snow: I agree with Mr. Lobdell in most of his remarks as regards the quality and price paid for wheels. You cannot get a good wheel without paying a good price for it. The best wheels in the country cannot be made without the use of the best irons. I mean by high irons which cost, say, $11 per wheel. You can guess how far a $10 or an $8 wheel will go toward the best quality. The best irons cost, say, $33 a ton. It costs to manufacture about 2 cents per pound, and if you want a 600-pound wheel it costs $12. That is the cost to the highest priced wheel that can be made of cast-iron. I believe that the freight cars of this country carrying 20 or 30 tons require as good a wheel as passenger cars, which do not carry any more load than they did 10 or 15 years ago, or perhaps a trifle more. To-day we are running on steel rails which are smooth. There is none of that lamination, that irregular hammering of the wheel. The passenger wheel to-day on steel rails will run further than it would five or six years ago. We need as good wheels under the freight cars as under the passenger cars. On the great trunk lines, where there are heavy grades, the brakes are applied to such a degree that the wheels expand, and under the expansion and in the winter time the sudden contraction after the cars get below the grades, the wheels break if they are of a cheap grade. The wheels that are made with cheap iron—short grained iron—are bound to break. The records of some roads given last year ought to startle every railroad man in the country as to the idea of using cheap wheels under freight cars. What we want is an iron in freight car wheels that is elastic, one that will contract and expand without breaking; and to get that iron you have got to pay a high price for it. There is no question about it. It must be a ductile iron, and it takes a good deal of charcoal to make such an iron. With a good wheel we can go through pretty rough usage with our freight cars. As to the weight of the wheel, I believe 550 pounds will carry the load safer than many wheels, made of a poor quality of iron, weighing 800 pounds. It depends upon the quality and the kind of iron that is put in them.

The President: It occurs to me that steel-tired wheels at the start have the advantage of being balanced, and by having been turned so that they are as nearly round as possible, and that the two wheels on the same axle are of the same diameter. I am of the opinion that the time is not far distant when all wheels, cast-iron especially, will

be ground or turned and balanced to a very great extent, so much so that we will find a vast improvement in the mileage, in the riding of the cars, in the comfort of the passengers, in the wear of the rails and the power required to move the train. I think gradually we shall take more pains in filling up all the running gear for cars, both freight and passenger. I am certainly of the opinion that it is very crude at present, and competition and low rates will drive railroad companies to do the best they can to reduce the expenses of running their roads.

I notice we have a number of novelties here in the way of driving wheels, car wheels and engine wheels, and I would ask if there are any gentlemen present who wish to make any remarks concerning them?

Mr. Charles G. Eckstein, representative of the Societe Cockerill of Belgium, exhibited a wrought-iron driving wheel made of one forging. The spokes are elliptical in section, and, after being roughed out, the wheel is heated in a special furnace and welded and stamped under the blows of a steam hammer. He stated that wheels of this description are used almost exclusively by the French railways, and are much employed in Germany, Austria, Belgium, Italy, Switzerland and England; also that they have been used on a train on the Pennsylvania road since 1876. The wheels are made by the Societe under Arbell's patent.

Mr. C. A. Smith: I would like to hear from the wheel men regarding the tread of wheels; I refer to the recommendation of the Association which failed to secure the required vote to adopt it. I have heard nothing from any one since it was decided not to adopt it, and I would like to hear what objections there are to the form proposed.

The President: It requires a two-third vote in order to adopt anything, which perhaps accounts for the tread not having been adopted. There was a large majority of votes cast in favor of it, but not a sufficient number to adopt the style of tread. I am very much pleased to hear the question raised, and I would like to hear from the wheel makers on the subject.

Mr. Snow: I was at one time very much in favor of the shape and form that was presented—a cylindrical tread that is conical part way up and then cylindrical from that to the throat of the flange. I was in favor of it until three years ago, when I got into the switch business, and I found that that kind of a wheel was sacrificing the point switches to a very great extent. When they went through they would strike the point switches and rest upon the thin point instead of resting on the main line part of the rail. I soon saw, if the wheels were made in that form, it would cost a very large sum of money to keep the point switches, which were very expensive, and this, with the fact that there was a little difficulty in making the wheel as represented, led me to change my opinion of it. We had 100 chills fitted up, and we made several thousand, and it was very difficult to get a wheel that would not sweat in the throat. It would sweat in spite of all we could do. I have given it a good deal of study, and made wheels for two or three years, but I cannot find a theoretical or practical way of getting over that difficulty. My objection was more particularly about sacrificing the switches. I think the old way of making the tread slightly coning, perhaps $\frac{3}{32}$, or something like that, is preferable for the chilled iron wheel than making it as some of the committee of the Master Car-Builders suggested. I think it is the cheapest for railroad companies to use, and when it comes to steel-tired wheels, sometimes they get two flanges in driving wheel of the locomotive, sometime they get an outside flange which is a bad thing to get. I was at one time in favor of the cylindrical tread, as I though there would be less flange wear. The Lehigh Valley and a few other roads had sharp curves and they were having no sharp flanges, and hastily I made up my mind that cylindrical tread was the thing to have, but the more we see the more we know. In traveling west, where they have 20 to 100 miles in a straight line, I found they were having more sharp flanges than the sharp curved roads. That led me to investigate a little, and I soon discovered by theorizing, that the truck as it leaves the curves and strikes a tangent, strikes in a quartering position, and it will remain in that position until it gets to the end of the 50 or 100 miles, or until it stops or strikes another curve, and not till then will it change. Theorizing from that I saw at once that roads with sharp curves were not as likely to get as sharp flanges as straight lines. Now, reasoning further, it appears to me that what we want is a conical tread, so that when on long straight lines with few curves, when we leave the curve and strike the tangent we want a conical tread to bring the trucks square in line. I believe that is the correct theory.

Mr. Lobdell: I never favored the excessive coning which has been employed of late years. I think it is a mistake, and doubt whether $\frac{3}{32}$ is not too great a cone to give the tread of a wheel. With regard to sharp flanges, I do not know of any class of mechanics which has more sins to answer for than the wheel makers. A great proportion of the sharp flanges is due to the manner the wheels are fitted to the axle and the axle to the truck. If one wheel is fitted a little further on the axle than the other they are going to grind and produce sharp flanges, while it is not the fault of the wheel.

Mr. Smith: At the last Master Mechanics' Convention there was a short discussion about the depth of the flange of a wheel, and I have thought of that many times since then and have examined many wheels. Some recommend that the flange should not be over 1 inch deep. Could a wheel maker make his chills better and produce a better flange by taking off a portion? I would also like to ask about the pressure that should be used in putting on a wheel. How great a pressure should a wheel stand without bursting?

Mr. Lobdell: If the hole is bored perfectly cylindrical and of uniform size throughout, if the axle is turned cylindrical, it is almost impossible to burst a wheel. I have applied a pressure of over 100 tons. But if the hole is not true, and the axle is not true, 10 or 15 tons might burst the same wheel. It acts like a wedge. Some wheels fail by splitting from the hub outwardly. Nine-tenths of the trouble of this kind is due to the manner in which they are fitted, and the great surprise to me is that more do not split. We ordinarily give a pressure of from 35 to 50 tons. We have furnished a road on the Pacific Coast several thousand wheels and axles. The wheels are all bored to a standard gauge, and the axles are turned to gauge, and when they come together any two wheels must go on an axle.

Mr. Smith: A wheel should then stand 40 or 50 tons pressure?

Mr. Lobdell: A wheel that will not stand 50 tons pressure should not be used, if the hole is well bored.

The President: While Mr. Snow may be perfectly correct in his estimate of the damage to points of frogs, I beg to differ with him as to the straightening of the truck under the car by the cone of the wheel. I doubt if there is cone enough of the wheel to overcome the friction necessary to straighten the truck; at least my experience never has led me to believe anything of the kind. That the oscillation of the car in moving along will gradually straighten the truck under the car in a very short distance I do not doubt, unless the friction is so heavy upon the side-bearings that it will take a very heavy pressure to straighten the truck. The causes of sharp flanges are undoubtedly numerous and various. Oftentimes I think the difficulty is in putting on two wheels not of the same diameter, and many times it is in the fit of the wheels to the truck and axle. I think to-day you might take any yard, remove the wheels from the freight cars, and you would have difficulty in finding three pairs of wheels of the same gauge and each wheel an equal distance from the end of the axle. I think if any one would take the trouble to select four pairs of wheels from any freight car that he might pick up, and remove them, taking proper gauges and testing just the relative position of the flanges to the journals, he would find that they varied so much that he would be surprised to think such work was done generally throughout the country. At least that was my experience in making tests similar to that. In fact I often found wheels of four different gauges under the same car, varying from nothing up as high as three-quarters of an inch. Now you could not expect wheel makers to produce wheels to wear satisfactorily under such circumstances, and I am thoroughly satisfied that the calipering of the wheels in order to get them of the same size upon the same axle is not as effectually done in most shops as it ought to be. I think many of them take the marks the wheel makers put on the wheels as being the same diameter, and wheel makers know what that means.

Mr. Snow: I have an instance in mind of a road which we were furnishing with wheels. They complained of sharp flanges and I went to see them about it. It was a good road, they paid their bills in thirty days. I hated to lose them, but on the question of right and wrong I could not help but give my sentiments. The first thing I called for was a rule, and found one wheel pressed on half an inch further than the other, and flanges badly warped on one wheel. The other was good. Well, as that was not the only pair, we went through the yard and found others. "Let me see your gauge," said I. I took the gauge, and always carrying a 6-foot tape in my pocket, I measured from the curve to the flange, and I found that they were pressing on their wheels to 4 ft. $8\frac{1}{4}$ in. That accounted for sharp flanges. Under those circumstances I could not help but being plain-spoken, and the result was I lost their trade.

President Garey: I would ask if there is any one present who has had experience with the cylindrical wheel; if they had any more sharp flanges than with the cone wheel?

Mr. Lobdell: I cannot answer that specifically. Cylindrical wheels are not a new thing. I made them prior to 1840, and they were used extensively on the P., W. & B. and before it was in any thing like the condition it is now, but for some reason they abandoned the use of them. I think they considered them more liable to derailment, although I never heard any complaints.

The President: I was present at a test made one time with cone wheels, coned $\frac{1}{4}$ of an inch, or $\frac{3}{32}$. I am not positive, and a straight tread. The tracks were painted for a quarter or half a mile. The line was straight until it struck a curve at the lower end of the track where the test was made. It was a steel rail, but I am not positive whether it was old or new. The locomotive was attached to the cars and they were moved around. They were new cars, fitted up at the same shop, never had been run before. The engineer was instructed to give as nearly as possible the same momentum when it started down the track. At first the cone tread wheel was tested, and we found that once in so far on the rail the flange touched it, first one side then the other all the way down; not exactly regular, but the distances varied somewhat. The rail was repainted and the straight tread wheel was pushed down the track. We failed to find a single mark of the flange on the rails from the time they left the locomotive until they struck the curve. The car ran quite a little distance beyond where the car with the cone tread stopped. The test was not such that we could make a report of it. We could not tell whether the locomotive gave the same momentum to the same car, neither could we tell whether the cars would run with the same momentum, consequently there was no report made of the test, although the test was such as convinced those present that a cone tread wheel would keep up a switching motion the entire length of the line.

Mr. Little: That calls up a little experience of mine when I was in the spring business on a line we all know very well. There was complaint made about the riding of the cars, and it fell to my lot to hunt up the trouble and make it right if possible. I found they were having everything to the springs. I found before I got through with it that the trouble was too much coning of the wheels. When the trouble was obviated by taking a little of the cone out there was no more complaint. The wheels were coned rather excessive, and when a portion of it was taken out the trouble ceased.

Mr. Lobdell: In regard to derailments, I would say that the road beds were not as perfect formerly as now, and when the wheels were pressed over to one side, one wheel was on the small portion and caused it to ride the rail. I do not think there would be the same tendency to derailment with the roads as now made.

Mr. Smith: I would like to ask why axles should not be larger in the center than they are, especially for a 42 inch wheel. I know the size in the center has been increased from our standard, but is it increased enough? I have had an idea of late that an axle in the center should be straight. Certainly there is spring there. If not, why is the small part put in? We want the axle as rigid as possible in the center, so with heavy loads it will not spring.

Mr. Blackall: We are using the Master Car-Builders' axle, but I have used it $\frac{1}{4}$ inch larger in the center.

Mr. Lobdell: Several years ago, we furnished some axles for some heavy passenger cars. They were to be erected for a Western road, and the cars had to run over the Pennsylvania trucks. When the cars reached West Philadelphia they were examined and refused passage over the road on account of the gauge not being right. I went up there taking along our gauge. It was applied on the top of the wheel. I found they were very much too wide for that road. I studied a moment and then I applied the gauge at the center and found it correct. The axles had sprung.

Mr. Snow: I find that a great many roads are doing just as Mr. Blackall says. They are making their axles $\frac{1}{4}$ inch larger than the Master Car-Builders' standard. We are often called to furnish Master Car-Builders' standard, and we have to take it as published, but I think there are more than a dozen railroads who are using more than $\frac{1}{4}$ inch larger in the center. I think it is a question that ought to be brought up.

Mr. Smith: Is there any advantage in any way to the axle to have it smaller in the center than at the wheel fit? Should it not be perfectly rigid? Should it not be large enough so that it will not spring at all? Would it not be better in every way when we are carrying the loads we are to-day, and the time is not a great way off when they will be heavier yet, to make the axle larger so that it will carry the load without springing? Some years ago examinations were made to find out how much variation the flange showed on a 20-ton car. The results show that every axle would spring with that load. Why not have it straight?

The President: I would state that at the time the Master Car-Builders' axle was established, the carrying capacity of the car was 10 tons. Now the carrying capacity has been doubled, and unquestionably the axle is too small in the center. The majority of the axles were as small as the center of the Master Car-Builders' standard, $3\frac{3}{4}$. Very few axles were in use that exceeded 4 inches in diameter. Now to increase the size of the wheel to 42 inches and leave the diameter of the axle in the center the same, certainly is not right, and it is a question in my mind if the axle is now large enough to carry successfully and with economy 20-ton loads, even with the increase in the center.

Mr. Blackall: In 1871, I think, our company had a thousand cars built, and we put under $4\frac{1}{2}$-inch axles, and they gave the very best satisfaction. Many of them are running to-day.

Mr. Lobdell: I am not an axle maker, but I have had considerable experience with them. It teaches me that there have not been any axles used that were equal to the old Bagnall axle imported from England. I have tried to break the journals of one of those axles by nicking it all around and then applying pressure to break it. It still showed the original formation of the iron. I am not prepared to say that iron may not become granulous by vibration, but these axles certainly showed the original formation after my attempts to fracture them. The Wilmington & Northern road sent to our shops about a year ago a lot of wheels and axles, requesting us to draw off the wheels and put in new axles where the old were not good. Several of these were tested, but failed to show any sign of being granulous. Several years before that we sent a lot of wheels and axles to Portland, Me., shipping from Philadelphia to Boston by steamer. In unloading them, an axle dropped and striking a pair of wheels broke short off. We immediately notified the party to whom they were consigned to have the wheels all drawn off and return the axles and that we would furnish others. The trouble was finally discovered to arise in the process of manufacture from the heater neglecting his duty during and allowing the fire to get down on one side, rendering one end of the axle granulous while the other end was fibrous.

The President: I am satisfied that many broken journals are caused by having been heated and cooled off by putting water on them. I was once standing by the side of a freight train in East Albany some years ago when the engine was doing a little switching, and it came into the track and ran down against the train. Opposite to me a journal dropped off. I had it taken out and put in the shop. The blacksmith heated it and worked the iron and said it was the finest he ever saw. I said that could not be possible, as it had just dropped off and showed a very granular break. I believe that every journal that gets heated and is cooled off with water is not suitable for use again. Take a passenger car that weighs so much. The journal is heated by friction and the revolution of the wheel soon gives a fine cracking at the shoulder, which can be easily discovered by heating the axle. I at one time tried a great many axles by putting them in the fire and bringing them to a cherry red heat, and trying them to see if they were good enough to put on wheels again. I found that one-ninth of all that were tested showed a crack at the shoulder. That was conclusive evidence to me that a shoulder at the inside of the wheel was not the thing to have, and from that time I ceased having any at the inner side of the wheel. While speaking of the subject of hot journals, it occurs to me that there are parties here who might enlighten us on the action of waste while in the boxes.

Mr. Blackall: Mr. Meneely is present from West Troy. He rigged up a Master Car-Builders' axle and invited me down to his place to see it work. The experiment was so interesting that I requested him to come here and exhibit it, not so much to show his lubricator, as to show the movement of the journal on the waste.

Mr. G. R. Meneely, assisted by Mr. John Gibbons, both of West Troy, N. Y., then exhibited a model of a journal-box. The box was pressed full of waste saturated with oil, making it as nearly as practicable the same as in service. The journal was then rapidly revolved, and it was noticed that the pieces of waste were drawn up around the journal, gradually creeping up under the brasses.

Mr. Meneely: This device takes the oil box just as we find it. We have the Master Car-Builders' box. If the axle were stone cold the waste would cling to the journal still more than it does now. It draws up all along the bearing.

President Garey: About how much more power does it require to move the journal with the waste than it does without it?

Mr. Meneely: In the model I should say at least ten times as much. The waste, of course, retards the motion, but Mr. Gibbons thinks it would take ten times as much. The little filaments of waste seem first to cling to the journal and keep creeping up, and finally getting under the brasses, and that will draw up others behind it, and by and by it will get larger and then spread out, and in actual test I have put the equivalent of a car running at a high speed in my foundry—regular Master Car-Builders' box, and run it sixty miles an hour—and when it is stone cold the waste will creep up, and in less than five minutes it will be drawn up to such an extent as to wipe the oil right off. I have an arrangement whereby I get something equivalent to a tonnage, and I find I can get up great heat in the journal box. The little clots of waste tightly packed down cause the heating. You can heat it without the waste by friction alone, but the waste aggravates it. I tried an experiment once by taking brasses that fitted per-

rectly, lifting it up a little and putting a little clot of waste down purposely. By this means I got a great heat at once, so that it was smoking.

President Garey: Then you infer that a great many hot boxes are formed in this way?

Mr. Meneely: I think they are often caused in this manner. If the journal was hot the waste would not crawl up. We thought we were mistaken at one time in regard to this, but we finally experimented and discovered the true solution. Where bearings have considerable play at the ends, say from ¼ to ⅜, the waste is apt to crawl up and finally wind round each end just like a spool. That, of course, would retard the motion, cause friction and make heat.

Concerning the lubricator, I may say that it takes a pint and a half of oil to lubricate a car with the device. It takes two and one-half quarts in the Master Car-Builders' box, and perhaps rather more than that for a 12-wheel car. Another advantage of this mode of lubrication is the saving in waste. I found by careful experiments that the Master Car-Builders' box will take from 12 to 14 ounces of waste. Suppose it is 8 cents, that would be 12 cents for waste. I find that in oiling a 12-wheel car (first oiling), suppose the oil costs 16 cents a gallon, will cost for a 12-wheel car $1.92. With this device it would cost 60 cents. Where the saving comes in is a provision for preventing the oil coming out behind the axle-hole. You have all noticed, as for instance on through trains starting for Chicago, that they oil about four or five times between here and there. I found by experiment made at Albany that the spurt of oil regularly used is just as near as you can get it to one gill. That costs half a cent, and this four times in 24 costs 2 cents, and for a 12-wheel car makes 24 cents. With this device you need not replenish the oil more than once in two weeks. I should, however, suggest that it be done once a week to be on the safe side. In any mode of lubrication, the oil will follow the axle arm, the centrifugal motion will draw the oil up, and we cannot prevent the waste of the oil working back and so get on the wheel, but we do prevent the oil running out by oiling. The dimensions of the tin box here are those of the Master Car-Builders' box. The lip is 1¼ inches higher than the hole behind, so you can see that when the oil is poured in it must run through behind, because of the 1¼ inches head which tends to drive it through, and we claim we save oil thereby. Then the oil deflector prevents the oil from slipping out. We have tried the lubricator with frozen oil, lard and melted lard. It did not start off instantly, but as soon as it became a little warm it went off.

President Garey: I think Mr. Meneely, in trying to see what he could do, has solved the cause of the discoloration of the journal bearings which we have all wondered at, and I am satisfied is now caused by the waste crawling up and getting between the journal and the journal bearing.

Mr. Lobdell: You cannot turn a piece of wrought iron perfectly cylindrical. The time may come when railroad companies will be willing to have their journals ground, and this is the only way you can get a perfectly round, cylindrical bearing. If they are not perfectly round, and the axle the same, it is apt to cause heating, and I think this is a great cause of trouble with new axles.

President Garey: In old times it used to be the practice to run all journals for a short distance in order to get them worn so that they would be safe to run on fast trains. Of late this has been abandoned. We are more liable to have hot boxes after the cars have been run a while, and everything would indicate that there ought not be hot journals. The cause has been attributed to hot bearings perhaps more than to any other cause.

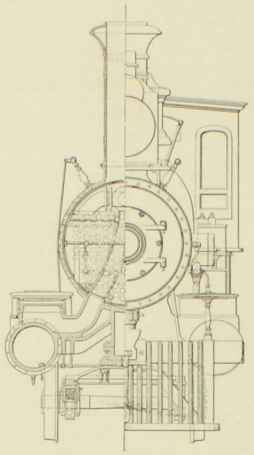
Mr. Barnes then exhibited a car coupler consisting essentially of three parts—the coupler, locking draw-head and the hook. Slack is secured and a simple movement of a lever opens the coupler. No springs employed. He also showed a model of a railway gate, all above ground, and so arranged that only a half or the two bars could be operated at pleasure.

A Unique Locomotive Feed-Water Heater.

Some years ago Mr. Henry Schlacks, superintendent of motive power of the Illinois Central Railroad, made a systematic attempt to utilize for steam making a portion of the heat that passes through the smoke-box and smoke stack of the locomotive. He made a stack with a lining that provided a hollow chamber to hold water, and the upper portion of smoke-box was also made with a water chamber that was in communication with the stack chamber. The cold water was pumped into the stack chamber, and from thence was conveyed by proper means to the boiler. The thing worked all right for a few weeks, and effected considerable saving of heat, for the feed water was raised to about the boiling point before it passed into the boiler. One day when the engine was in the house, Mr. Schlacks was looking at the heater, when he saw a drop of reddish water leak from under the smoke stack base, and run down the smoke-box. On examining closely, he observed that the drop cut a tiny furrow on the iron it ran over, and he decided that a probable bad cause of corrosion was present; so that day he had the delivery pipes from the pump and injector so arranged that water could be put into the boiler direct. He also made provision for shutting off communication between the heater and the boiler by stop-cocks. The precautions were not taken any too soon, for on the next trip the heater developed a bad leak.

Mr. Schlacks collected some of the powder left by the corrosive agent, and took it to a chemist for analysis. This gentleman interested himself in the case and made some investigations. He concluded that the comparatively cold surface of the heater acted as a condenser on the steam and sulphurous gases passing from the fire, and that a reaction took place, producing small quantities of sulphuric acid, which attacked the iron plates. On figuring up the cost of construction and maintenance of heaters made in this way, and the saving to be derived from their use, Mr. Schlacks concluded the invention would not pay, so it was abandoned.

Standard Passenger Locomotive (Class A) New York Central & Hudson River Railroad.



The above cut should have been inserted with the illustrations of this locomotive in our last issue, but was accidentally omitted. We now supply the omission, and refer our readers to the other cuts and accompanying description, which will be found on page 157 of our December number.

Mr. Coleman Sellers on Boiler Tests.

In the course of a lecture recently delivered at the Franklin Institute, Philadelphia, Mr. Coleman Sellers made the following interesting and lucid remarks on boilers:

"Steam boilers have been made to serve the purpose of death traps from the most culpable neglect of ordinary precautions for safety, coupled with gross ignorance of Nature's laws, until the authorities were obliged to step in and define by laws certain precautions that must be taken for the welfare of the community. Steam boilers are made of sheets of iron or steel bent into shape and joined by rivets. As the strength of the entire structure is limited to the strength of the weakest individual part of the structure, it is of moment that the true value of any particular kind of riveted seam be known by actual experiment.

"There is no way of making the riveted seam as strong as the body of the metal. It is now usual to so proportion the number and size of the rivets to the thickness of the plates to be joined, that the metal remaining between the rivet holes shall about equal the strength of the rivets that unite them. In determining the pressure of steam a boiler already made can be permitted to work under, a calculation is gone into as to the strength of the seam, as measured by the area in section of metal between the rivets, and also measured by the size and number of the rivets, and the strength of the seam is assumed to be the lowest result of the calculation. After this, it may be necessary to know the strength of metal that forms the boiler, and just here is where the lesson of the ball and the string comes into play, and our present illustration is as readily understood. It does not require a very high order of talent to master the calculations that are resorted to, to determine what strain will come on this or that part of the boiler, and we have to rely wholly on calculation for that information. The boiler must be made much stronger than its ultimate or breaking strength of the metal to insure its safety in use, and to allow for deterioration. The difference between the ultimate or breaking strength and the strain that it is to be subjected to in practice, is regulated by what is termed the factor of safety. All well-considered specifications for structural metal work, for instance, call for the material to come up to some established standard of ultimate or breaking strength, and the amount of metal to be used in the structure is determined by a factor of safety specified. This factor of safety may be as low as four, in some cases of boiler and bridge construction, when the known character of the material used warrants the course, or it may be as high as thirty, in the case of matter subjected to shock or blows, as in the case of rapidly-revolving gear wheels. That is to say, it may be considered safe to strain the structure to one-fourth of what would cause it to break, or the case may require that we dare not strain it beyond one-thirtieth of its breaking strength. The question now presents itself, how can every sheet of iron or steel to be used in the construction of a boiler, for instance, be tested, when such sheets are usually ordered from the mill of the exact size that is required, and to test a part of such sheet would destroy it for use. This furnishes me with a suitable example of the scientific method carried out with ease and certainty in every-day practice.

"Steam boilers of locomotives are worked at a rather high pressure, say 120 or 130 pounds to the square inch, and the metal now mostly used in their construction is steel of a low grade as regards hardness, that is, steel of considerable ductility. From the specifications for boiler and fire-box steel issued by the general superintendent of the motive power of the Pennsylvania Railroad, December 1, 1882, I extract the following:

1. A careful examination will be made of every sheet, and none will be received that show mechanical defects.

2. A test strip from each sheet, taken lengthwise of the sheet, and without annealing, should have a tensile strength of 55,000 pounds per square inch, and elongation of 30 per cent. in section originally two inches long.

3. Sheets will not be accepted if the test shows a tensile strength less than 50,000 pounds, or greater than 65,000 pounds per square inch, nor if the elongation falls below 25 per cent.

4. Should any sheets develop defects in working, they will be rejected.

5. Manufacturers must send one strip for each sheet (this strip must accompany the sheet in every case); both the sheet and strip being properly stamped with the marks designated by this company, and also lettered with white lead to facilitate matching.

"Now let me explain this specification to you as it has been explained to me in the admirable test-room of the shops at Altoona:

"There are many makers of steel boiler plate in the United States, and without referring by name to any one, I can state that the Pennsylvania Railroad has decided on a set of arbitrary signs to indicate each maker. One is designed by a triangular stamp, one other by a circular stamp that marks a ring of about one inch in diameter, another by a square of like size, and so on. Sheets of steel come from the rolls with a more or less irregular outline and of a size that will permit the test strip to be cut off from one or the other edge without difficulty. The plate in the rough is, when cold, scribed to the required size of sheet that is to be sheared to, and on the shear line two marks are made by the prescribed stamp, each mark being made at one blow of the hammer and the other by the same punch or stamp at another blow, and at any convenient distance from the other, but in no case are the two marks made by a twin set of punches or stamps at any fixed distance one from the other. This irregularity of the stamping renders the after matching of the strip, or coupon as it is called, an easy matter, with the sheet from which it has been cut, the shear cuts being made directly through the marks. The matching is still further facilitated by numbers or signs in white lead.

After reception by the proper inspectors on the road, the samples or coupons are stamped with corresponding numbers after verification, and the test piece goes into the shop to be dressed to the proper width for the test, and the sample is then broken in a testing machine, and, in a book kept for that purpose, entry is made of every particular connected with the test, and the sheet received or rejected on this record. Suppose, however, that a sample shows a higher tensile strength than the maximum allowed, namely, 65,000 pounds per square inch, and that such a specimen has an elongation or ductility as great as can be desired, it may well be asked why it should be rejected. In the book of record, I have seen some such cases, and reference is there made to the book of the chemist, into whose hands such sample is sure to go. His chemical test had in all cases, up to the time I saw the book, indicated too much carbon in the steel and a simple physical test of heating and plunging, the hot steel into cold water has shown it to be capable of being hardened. It is not deemed wise to employ any metal that has hardening qualities in the construction of steam boilers. After many such trials, the officers of the road have come to consider the tensile and ductility tests as final, and as expressive of the qualities wanted. Thus, you see every sheet in every boiler has its physical quality when new recorded, and its marks enable its after history to be noted. No sheet of steel can meet with mishap afterward, without having the report of the mishap recorded on the page that marked its acceptance, and its life history or durability also noted. Such, in brief, is the account of the admirable scientific investigation into the quality of the material used in boilers, as reduced to practice, and so persistently pursued by this one company as to be now no longer a subject of comment. This method of test, however, is the outgrowth of systems that preceded it. Practice and theory must agree. The scientific engineer can lay claim to the title only when he is abundantly fortified by sound experience, and has learned to view all things evenly.

"In the specification of the Pennsylvania Railroad, as already cited, stress is laid on the percentage of stretch before rupture takes place in the required test. The date of the printed specification I have referred to is 1882. On January 8, 1881, I had a letter from the general superintendent of motive power, in which he describes other tests which had been used for a long time. These were bending tests.

(1) Bending cold.—A strip from each sheet must stand being bent over double, and being hammered down flat upon itself without fracture.

(2) Bending after being heated and dipped.—A strip from each sheet must stand being bent over double, and being hammered down flat upon itself, after having been heated to a flanging heat and dipped into cold water, without sign of fracture.

"He informed me that the bending tests had been insisted on for several years, but that the certainty of the ductility test had caused them to make it the final mode of determining the quality of the steel submitted to them. In order to make the bending as uniform as possible they adopted the plan of holding the strip to be bent between rigid jaws and striking the projecting end with a 10-pound sledge until it is deflected about 135°, when it was removed from the jaws and held with tongs while it was hammered down flat on an anvil. The bending after heating and dipping was added to protect them against acceptance of hard sheets, by reason of the test strips being annealed, accidentally or otherwise by the manufacturers. He said that for some time past they had been testing tensilly, to obtain ultimate strength and ductility, a piece from the strip sent with each sheet, and had established a tensile test, which supplanted the bending test, but covered the same ground that it did. This was done on account of the greater regularity and uniformity of the results in tensile test, and because by it they obtain figures to show the exact quality of the steel; so that even in 1881 they were working under the specification I have already mentioned, as furnished me in 1882. Time is an important element in tests, particularly so in bending tests. An expert giving testimony in a trial in which the reliability of the steam-engine indicator was in question, said: 'I believe it is the result of the use of the indicator when I know who works the instrument.' The bending test is good, when you see it done in a proper manner, or know who does the bending."

Performance of American and English Freight Locomotives Compared.

In his paper on Locomotive Engines read before the Institution of Civil Engineers (London), Mr. Stroudley, locomotive superintendent of the London, Brighton & South Coast Railway, describes the construction and working of a freight engine that appears to be regarded as about the highest type of its kind in Great Britain. We reproduce indicator diagrams taken from that locomotive, and place opposite them diagrams taken from a Brooks locomotive pulling a freight train on the Burlington, Cedar Rapids & Northern Railway.

The Stroudley engine is of a type very common in England. The cylinders are 18½ × 26 inside connected, with three pairs of drivers 5 feet diameter connected, and no other wheels. The boiler has 1,413 square feet of heating surface, and 21 square feet of grate. Pressure of 140 pounds is carried on the boiler. This engine is capable of exerting 144 pounds per pound of cylinder pressure.

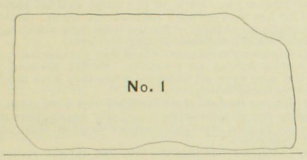
The Brooks engine is an ordinary ten-wheeler, with three pairs of drivers 56 inches diameter connected, and a four-wheel truck carrying the front end. The cylinders are 18 × 24 inches. The total heating surface is 1,281 square feet, and the grate area is 17 square feet. This boiler also carries steam of 140 pounds pressure. The engine is capable of exerting a tractive force of 139 pounds per pound of cylinder pressure.

The London, Brighton & South Coast Railway is spoken of as a hilly road, with up and down grades throughout, so that it requires powerful engines to operate the trains. An inspection of the grades on which the diagrams were taken, shows us that the prevailing grade has a rise of 1 in 264. Card No. 1 of the Stroudley engine was taken on that steepness of ascent, which is 20 feet to the mile. As the diagram is very full, and the engine was working slow, it is presumed the load was nearly all the engine could pull. The load consisted of 795 gross tons. According to the diagram, the engine was exerting 240 horse-power, or 243 horse-power when figured by the well-known tractive formula. Taking the figures 240 as correct, they represent 7,920,000 pounds exerted through 445.8 feet per minute. On a grade of 20 feet to the mile the train would have to be raised 1.68 feet per minute at the speed indicated. The gross weight of train being 1,780,800 pounds, there would be 2,991,744 pounds expended raising the train up the grade, leaving 4,928,256 pounds to overcome the ordinary train resistance, or close on 14 pounds to the train ton. This is extremely high for a speed of five miles per hour, and indicates that the trains on the London, Brighton & South Coast Railway are tremendously hard to pull, or that the engine absorbs an enormous amount of power in overcoming internal resistances.

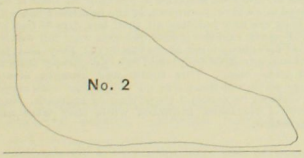
The train moved by the Brooks locomotive, from which the diagrams were taken, consisted of 642 American tons, the weight as in the other case including engine and tender. The Burlington, Cedar Rapids & Northern Railway is also hilly, but their altitude is considerably greater than the Surrey Downs traversed by the London, Brighton & South Coast Railway. Diagram No. 1 was taken when the engine was toiling slowly almost at the summit of a grade that rises 60 feet to the mile for over a mile in length. With the horse-power indicated, the engine was exerting 7,227,000 pounds through 410 feet per minute.

STROUDLEY LOCOMOTIVE.

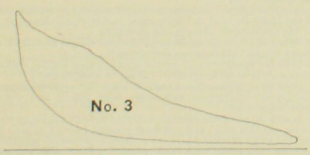
Diagrams taken with Crosby Indicator, spring 80 pounds.



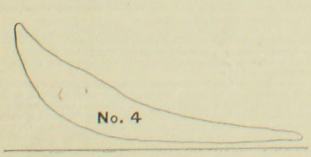
Steam chest pressure	140 lbs.
Speed	5
Revolutions per minute	28.4
Cut-off	78 per cent.
Gradient	20 feet up.
M. E. P.	125
I. H. P.	240.75



Steam chest pressure	140 lbs.
Speed	13
Revolutions per minute	73.84
Cut-off	26 per cent.
Gradient	20 feet up.
M. E. P.	87.2
I. H. P.	436



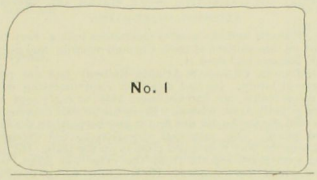
Steam chest pressure	140 lbs.
Speed	27
Revolutions per minute	153.36
Cut-off	17 per cent.
Gradient	20 feet down.
M. E. P.	47.40
I. H. P.	498



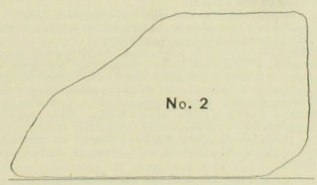
Steam chest pressure	130 lbs.
Speed	39
Revolutions per minute	221.52
Cut-off	17 per cent.
Gradient	20 feet down.
M. E. P.	31.60
I. H. P.	474.88

BROOKS LOCOMOTIVE.

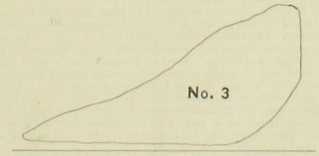
Diagrams taken with Tabor Indicator, spring 64 pounds.



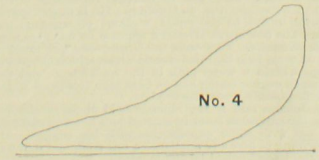
Boiler pressure	140 lbs.
Speed	4.6
Revolutions per minute	28
Cut-off	91 per cent.
Gradient	60 feet up.
M. E. P.	127
I. H. P.	219



Boiler pressure	140 lbs.
Speed	10.5
Revolutions per minute	64
Cut-off	87 per cent.
Gradient	45 feet up.
M. E. P.	98.8
I. H. P.	380



Boiler pressure	135 lbs.
Speed	29.3
Revolutions per minute	176
Cut-off	25 per cent.
M. E. P.	47
I. H. P.	510



Boiler pressure	135 lbs.
Speed	36
Revolutions per minute	216
Cut-off	25 per cent.
M. E. P.	33
I. H. P.	506

On this grade of 60 feet to the mile, the train had to raised vertically 4.65 feet per minute at the speed indicated. Multiplying the gross weight of train, or 1,284,000 pounds by 4.65, we obtain 5,970,600 foot-pounds of work done in lifting the train up the grade, leaving 1,256,400 pounds for overcoming other resistances. This gives slightly over 4 pounds per gross ton, which is a fair average of the power required to move American freight trains on good track.

In taking the train over this hill, the engine obtained no advantage from the inertia represented by high speed at the foot of the grade, for two brakes had been left set on the train through carelessness, and the engine stalled on the middle of the hill. By taking the slack of the couplings, the engine pulled the train over after the brakes were released, and the diagram was taken when the summit was nearly reached.

Diagram No. 2 was taken on a grade of 45 feet to the mile, and shows an excellent distribution of the steam. If American freight locomotives were operated so that no heavier work than that represented by this diagram was habitually exacted, the engines would show a much higher economy than they do in the use of fuel.

The other diagrams were taken on descending grades, and give a good account of the steam passed through the cylinders.

A belief is entertained by many mechanical men that the British locomotive is economically much superior to the American engine, owing to some structural merits of the former. The chief end of good locomotive designing is to make the minimum of steam do the maximum of work in a durable machine. We do not see that the diagrams taken from the Stroudley locomotive, or the record of the work done, indicates any superiority over the unpretentious American locomotive.

The diagrams from the Brooks locomotive represent the work done by an ordinary American engine pulling an ordinary train, the kind of work that hundreds of other railroad locomotives are doing daily all over the United States and Canada. No preparation whatever was made for the trip, and no selection was made of the train.

New England Railroad Club.

The regular meeting of the Club was held at the rooms of the Boston & Albany R. R. passenger depot, Dec. 9. Mr. J. N. Lauder occupied the chair, and announced the subjects for discussion to be Car Seats; Combination Springs for Cars and Locomotives; and "Which are the Best Springs for Freight Cars, Spiral or Elliptical?"

CAR SEATS.

Mr. M. N. Forney, of New York, read a paper on this subject, and exhibited a model of a car seat invented by himself, which he claimed was specially adapted to the form of the human body, the seat itself being broad, slightly concave, elastic, and slightly elevated at the front edge; the back of the seat inclining backward, projecting at the lower part, to accommodate the small of the back, and also at the top to accommodate the head, and when turned over and reversed, presenting the same features. Mr. Forney said that a car seat should be so made as not to make it necessary for the sitter to twist into the deforming shape of the seat; that the seat must be low enough to allow the feet to rest easily upon the floor. The seat itself should be concave, and so upholstered that it will be easy and adapt itself to the body. The back should have a projection at the lower part to fit into and support the lumbar region of the back; then concave and retreating to receive the shoulders, and project again at the top to afford a rest for the head. Of course it was impossible to construct one that would exactly fit every back, but an average may be struck that will make a very comfortable seat. And lastly the seat should be tilted back so that the angle of inclination shall counteract the tendency to slip off, and the back be somewhat inclined to give greater ease. These features had been embodied most thoroughly in the seats in the first-class compartments of English carriages, as it can be done there without any difficulty, the seats not being reversed. The lower portion of the back is well filled out and stuffed with curled hair, while the upper portion is also rendered soft and shaped to fit the contour of the body. In American cars, however, every thing seems to have been sacrificed to the prejudices of the upholsterer, and we have our convex seats and backs that do not permit of any ease.

Mr. F. D. Adams referred to a car seat he had recently seen which was constructed on an entirely different plan from that of Mr. Forney, the whole seat having a rotary movement and revolving instead of the back turning over. They can be upholstered so as to fit the shape of a man very comfortably, and are less open to objection than any seat with a reversing back. He approved of Mr. Forney's suggestion to place his seat in a drawing-room car, and let the public judge of its comfort and convenience, and determine whether they prefer his double seat to an ordinary parlor car single chair. We are apt to follow in the footsteps of our predecessors, and therefore have adhered so long to the ordinary chair. Messrs. Pottier & Stymus did a great service to the public when they produced an improved chair. The Boston & Albany road had ten cars fitted with chairs in that style. The form of the back is a very great improvement over the ordinary car seat. The tipping of the seat is not new, but is a great advantage in preventing one from slipping off. It is uncomfortable and tiresome to sit on an entirely flat seat; and if it is convex we slide off, and if considerably rounded it is very difficult to sit on. But it requires a good deal of decision to induce an upholsterer to make a concave seat; he imagines that he cannot make it so handsome, and so he opposes it, and it is a difficult matter to get him to upholster a seat as it ought to be.

Mr. W. W. Snow said that in his travels he had two or three times got into a car with rattan seats, somewhat concave in form, with no upholstery at all, and had been less tired at the end of a day's journey than if he had sat on any other seat; and for long rides, a rattan seat made

the form of the one described by Mr. Forney would be best.

Mr. H. A. Little, referring to the Broadway street cars, in New York, said that those built by the Stephenson Co. had concave seats, and those built by the Pullman Co. had convex seats, and he always picked out the former to ride in.

Mr. Coleman said that a man could ride a thousand miles in the seat presented by Mr. Forney with less fatigue than he would experience in riding a hundred in an ordinary car seat. There was nothing more uncomfortable than the average car seat. He had noticed in the English, French, and especially the German cars, there was a great deal of attention paid to this idea of having the seat conform to the body, and for this reason there are no more comfortable cars than those of Germany and Russia. Where there is any jolting of the car, the seat should be covered with some material that affords a certain amount of friction. On the Italian roads the seats are covered with a material made of silk and linen, exceedingly neat and clean-looking; it wears well and appears exactly the right thing at first glance, but it is slippery and hard, and ladies who sit on them and wear silk dresses, find at the end of their journey that the silk has acquired a polish from the seat which can not be removed. Therefore, something of the nature of plush is needed for the covering of the seat, to afford a certain hold and prevent slipping.

Mr. John Coghlan said the only objection that occurred to him to Mr. Forney's plan was, that in a double seat of this kind the occupants would not be so independent as if separated in single chairs. But for one person it would be an excellent seat for a long ride.

Mr. Coleman said that the average car seat now in use was too high for ladies to sit in with comfort.

Mr. Forney said his idea was to have the seat he had designed put in drawing-room cars in place of chairs, and if sold at the same price as chairs, a person can have the exclusive use by buying the whole seat, or if he desires to take his wife or friend or some other person in with him, he can do so.

Mr. Adams said that some two years ago he concluded the seats were too high, and made them two inches lower. Some tall people thought they were too low; but they have been used ever since, and he had made all his seats of this height. Occasionally they are called too high. Every seat is about 16 inches to the top of the cushion.

Mr. Lauder said the Buntin rotary seat had advantages aside from what appeared on the surface. The seat can be upholstered in any way you like. You can have any form of seat you like, because it has a rigid tilt, and you can tilt it as much as you please. It will admit of the easy cleaning of the car. It is difficult to clean under the ordinary car seat, where there are foot-rests, and sometimes steam-pipes. But the rotary seat can be swung round against the window, and then swung the other way, leaving nothing except the round center pedestal to obstruct the free circulation of the broom and mop, if the steam-pipes are run on the side, as in parlor cars.

Mr. Adams said the back of the Buntin seat was concave both longitudinally and vertically. The end was comparatively round, and the back followed round in connection with it, and was very comfortable.

Mr. G. F. Small, of the Hale & Kilburn Manufacturing Co., Philadelphia, spoke of the difficulty of adapting seat backs to suit every one. He had had some experience in upholstering seats. If the seat is concave and rigid in front, while you are sitting straight, you will find it very comfortable for a little while, but if you turn on one side you have then not as comfortable a seat as the old convex seat, simply because, if the latter is properly upholstered, with proper springs underneath, the person sitting on it will make his own impression in it and it will conform to his body. He had tried the concave seat in every way with springs of different kinds, and finally he was instructed by Mr. Adams to make the seats as we formerly made them, and have done so since. He had exhibited at the Chicago Exposition a seat intended for a parlor car, which was similar to Mr. Forney's, only it had not the concave back, but had a concave seat and also a pillow at each end. It was found to be impracticable on account of the cost, being more expensive than the old style of seat or the chair. For the regular passenger car, the only true and proper form of seat is the convex, properly upholstered. There was no seat spring now in the market so well suited to the purpose and so economical as the Hale & Kilburn spring.

Mr. Coleman had traveled extensively abroad, and was struck with the superiority of the seats in European cars over ours.

SPRINGS FOR CARS AND LOCOMOTIVES.

Mr. Lauder thought it was useless to discuss springs for locomotives, as they had got down to a solid basis, brought about by the necessities of the case. Elliptic springs might some day be used on the equalizing bars of car trucks. He referred to the spiral springs devised by the late Mr. Gleason for cars of the Old Colony road. These springs are used on the bolsters, and have a soft and easy motion on the equalizing bar. They have just the right weight and tension to hold the car up.

Mr. Adams said elliptic springs were the best, but could not be used very well on equalizing bars. He had one car hung on side elliptics which made it ride very easily. He dispensed with the equalizing bars, and in order to get as light a truck as possible, put in elliptic springs in the jaw over the wheels. Rubber equalizing springs and elliptics for bolsters were formerly used, but there were no good rubber springs to be had now. An elliptic wheel spring would be superior to any thing now in use.

Mr. Grigg said that unless the boxes are free in the pedestals the equalizer springs did not do much good. Every thing depended upon getting the proper weight and tension. The spiral springs should be of large diameter and the bar as flat as possible in order to secure easy riding.

Mr. Little said the action of the spiral was short and jerky, and the elliptic long and easy. The springs should be so arranged that the action should be two to one and not three to one, so they will all go and come alike, not the bar spring coming up as the elliptical spring is going down. This can be ascertained by testing the motion of the elliptical, and then the motion of the coil spring, and getting them to work uniformly, so that the coil will go down and come back with the elliptical.

Mr. Adams said the motion of the spirals depended on the length of the coil. The movement has to travel through the length of the steel, and the longer the coil and the larger the diameter, the slower the motion will be.

Mr. Lauder said if the bolster was not perfectly rigid it acted as an imperfect spring and caused a trembling motion. He thoroughly believed in elliptics for both freight and passenger cars. They cost three times as much as spirals, but it was money well spent.

A letter was read from Mr. John A. Kent, of the A. French Spring Co., in which he says:

"An elliptic spring gives the best results, but as it occupies a considerable space, it cannot always be used. A spiral spring will be more durable and ride more easily than an unduly short elliptic spring. Trucks should be constructed to admit of long elliptic springs. Spiral springs are often made either too large or too small in diameter. If the diameter of a spiral spring is too large the section of bar must be increased to give the proper strength, and hence the section is so large it cannot be properly tempered. If the diameter of the spring is too small the spring rides too rigidly, and weight of steel is saved at the expense of elasticity and durability. The happy medium can be ascertained by considering the weight to be carried, and constructing a spring accordingly. Spiral springs are often made so strong that easy riding is impossible, in some cases the carrying capacity being five times the actual load. Such a spring would have no more elasticity than a block of iron or wood. Too much reserve power is as bad as not enough capacity. Every practical spring manufacturer knows that there is a limit to the maximum capacity."

Western Railway Club.

The regular monthly meeting was held in the club rooms, Chicago, Dec. 16. There was a fair attendance, Mr. Verbryck occupied the chair.

AGAINST PUBLISHING THE PROCEEDINGS.

Secretary Forsyth thought the practice of publishing full reports of what was said at the meetings interfered with the freedom of discussion, and he made a motion that the press in future be supplied with only an abstract of the proceedings.

Mr. Rogan and several other members objected to curtailing the reports, but on the motion being put to the meeting it was carried.

MATERIAL FOR LOCOMOTIVE SMOKE STACKS AND NETTING-EXTENSION SMOKE BOXES.

Mr. Forsyth said the master mechanics had a very full report on this subject at their Chicago meeting, and asked if Mr. Johann had read it.

Mr. Johann, Chicago & Atlantic Railway, had not read the report lately. He had intended experimenting with extension fronts, but had not been able to carry out his desire as fully as he wished. From his limited experience with that device he did not find it any better than the diamond stack. The principal objection to the diamond stack was the way it dropped cinders on the train. He had heard some good reports from the extension front, but others said it was not good. He was now using the diamond stack on the Chicago & Atlantic Railway, and would keep to it, till he heard more inducements to change than had come to him yet.

Mr. Cooke's experience had been similar to that of Mr. Johann. They are using the diamond stack and have no extension fronts on the road. He had heard good and bad reports about the extension front and was waiting for more light on the subject.

Mr. Forsyth said they had only one extension front. It was applied to a special engine and gave so much satisfaction that they expected to put on more.

Mr. Bryant, Chicago & Iowa, had made a good many experiments with a stack he had been using for eight or nine years. It was a diamond stack with a perforated plate instead of a netting. He finds the plate cheaper and much more durable than netting, and it performs the functions of a netting quite satisfactorily. This arrangement made a good, cheap, durable diamond stack, but it had the fault of all other diamond stacks of throwing cinders on the train. He had no experience with extension fronts.

Mr. Johann believed that the extension front was an evolution of fashion just as much as a woman's bonnet. He thought it caused too much work, and doubted if it was economical. He had heard men claim they saved 30 per cent. by use of the extension front and brick arch, but he did not believe it.

Mr. Cooke had been anxious to find something that would do away with the cone, and had tried a single high nozzle. It was not satisfactory.

Mr. Forsyth was not surprised to hear what Mr. Bryant said about the durability of the cast iron grating compared to netting. Anything that would run a year without renewal must represent considerable saving compared to the expense of netting. They had found that a steel netting wore out in 4,500 miles. If a cast iron substitute would wear a year it would be a great saving. A large area of netting in top of the stack wears better than a contracted area. He thought it would be as well to adopt the extension front as to enlarge the top of the stack very much. They found the extension front steamed as well as the diamond stack.

Mr. Sinclair had never had charge of an engine with an extension front, but he had been round a great deal among those who are using them and believed they effected a saving. Although he had not had charge of engines with the extension front, he had been brought up among locomotives with the open stack, and considered that putting an obstruction in the stack led to great waste of heat. They had to increase the speed of the gases to overcome the obstruction. He believed spark-throwing could be prevented without obstructing the stack. The best spark-arresting engines he had ever seen had open stacks. They were the Groesbeck spark arrester used on some Erie Railroad locomotives, which projected the sparks into a water-tank in the smoke-box; and the Buchanan engine which had an extension front and water space diagonally across the fire-box.

Mr. Johann said if Mr. Sinclair held these sentiments about the extension front he wanted him to come and help him out with some experiments with his engines. He was willing to give any appliance a fair trial, and if it was really an improvement he would use it.

Mr. Cooke said he was also in the way of finding out the exact value of single nozzles, and if Mr. Sinclair had any time for expert work of that kind he would like his assistance.

A desultory conversation then ensued on various locomotive matters, after which the discussion was closed.

SPECIFICATIONS FOR INSPECTION OF CONTRACT CARS.

Mr. Snow opened the discussion on this subject. He had come to the conclusion that if cars were to be built by contract, five inspectors ought to be present all the time. He found great fault with the work done on some passenger cars they had built at a contract shop.

Mr. Gore said the specifications were sometimes changed by general managers.

Mr. Cooke's experience had been quite the reverse of Mr. Snow's. They got some cars made by contract, and he was surprised to find how well they were made, considering the price paid. The piece system is so well worked out in the contract shops that they get the cars built much cheaper than they can be put up in the ordinary railroad shop.

Mr. Verbryck said they had very few cars built by contract, and he was not in favor of it. They got a contract built car to repair lately that had the roof blown off, and they found only one nail had been used to hold it on.

Mr. Snow said they had worse cases than that, and gave particulars of bad work being done on trucks.

Mr. Townsend did not think any of us could afford to give a dollar for ninety cents. There was no M. C. B. but could build cars as cheaply as contract shops. But when an M. C. B. required $600 to build a car and a contract shop only got $550, the buyer could not get as good a car. When contract shops get a low price they must put in poor work and poor material. If the buyers were a little more liberal better cars would be built.

Mr. Bryant thought the blame was to some extent with the builders, for they underbid each other. If it was not for that practice the railroad companies would pay a fair price for cars.

Mr. Townsend did not wish to cast reflections on any one for trying to buy cheap, but people ought to know that cars were often built too cheap for good work and material.

Mr. Snow said the owners of contract shops get material lower than railroad companies. When they were paying 2 cents for iron, the contract shops were buying it for 1½ cents. It was about the same with everything else. On the whole, they get pretty good cars from contract shops, but when they come into the shop for repairs a great deal of bad work is found.

Mr. Gore said contract builders could purchase material cheaper than railroad companies, and their systematic way of carrying on piece work in the shops enabled them to build for less than ordinary railroad car shops. Builders were nearly all in favor of having inspectors attending to the interests of companies getting cars built.

Mr. Townsend mentioned where they got cars built, and the builder wanted an inspector. He did not send one, but the cars were all inspected when they were finished and were found satisfactory.

Mr. Johann thought if the specifications were made out correctly and all the contracts properly drawn, that they could get as good cars from contract shops as they could build themselves.

Mr. Townsend held that the first cost did not represent the value of a car. When cars were poorly built they cost too much for repairs.

Mr. Johann entered an energetic plea in favor of a greater effort being made to establish standards in the parts of cars.

Mr. Townsend did not see how standards could be settled on when the increase of size kept going on.

Mr. Verbryck said that on the Chicago, Rock Island & Pacific road they have three classes of freight cars. When he gets an order for material to put on a car that is being repaired anywhere, he knows by the number what will fit it. They are now building all their box cars 34 feet long.

Mr. Forsyth said the proper question was, can we build as good and cheap a car as we can buy? They had tried, and it was admitted they could buy cars cheaper than they could make them. This result was brought about in various ways, but there was no doubt that cars could be built cheaper by contract shops than by railroads. He was in favor of cars being inspected while they were under construction.

American Railway Master Mechanics' Association.

INQUIRIES ABOUT DRIVER BRAKES.

The following circular of inquiry has been sent out from the secretary's office:

The driver brake committee request an early reply to the following queries, viz.:

1.—Are there any circumstances under which you would recommend the application of driver brakes, and if on all classes of engines, viz.: passenger, freight and switching?

2.—What are the best substances, the best shape, and best size for brake-blocks to be used on steel tyres?

3.—Does the application of driver brakes lessen engine mileage between each tyre turning, etc.? If so, to what extent?

4.—Does their application lessen mileage between repairs that can be got out of journals, axle boxes, horn blocks and wedges, side rod brasses, etc.?

5.—Is any injury done to engine or side rods by applying brake blocks on one side only, and between wheels (wedge type), thus forcing the axles further apart, or is there a practical advantage in gripping each wheel with brake blocks on both sides (compression type)?

6.—Is it advantageous to couple driver, tender and train brakes, so that one handle or valve will apply the whole?

7.—Which is the best position for brake blocks so as to give the greatest power and least interference with the elastic action of the main springs?

8.—What percentage of the weight of the drivers is it judicious to utilize for brake resistance in view of the train breaking loose, and the possibility of the front (by the automatic application of the brake), being brought to a stop earlier than the rear portion, thus causing in a rear pitch-in?

9.—Do you recommend the application of steam or other form of power-brake on drivers when the train is not provided with any form of continuous brake—or, in other words—is there any element of danger in having a powerful brake resistance at the front end of the train?

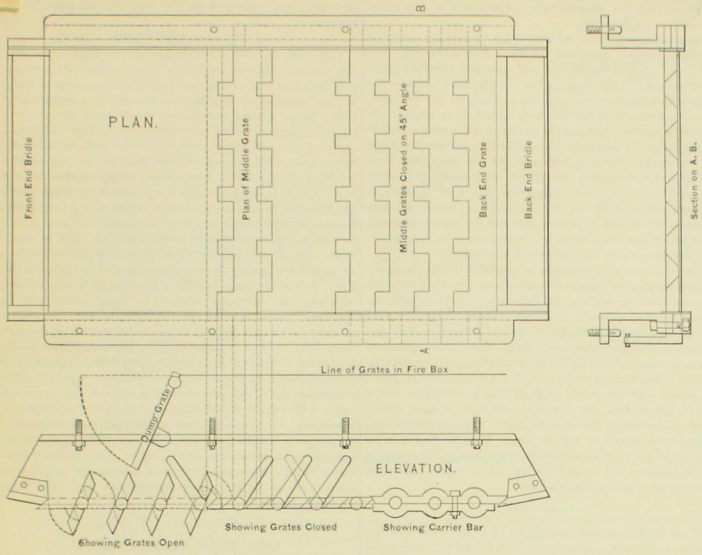
10.—As there are several ways of applying brakes through an electric current, should the electric wire be so connected with the source of power that the touching of a button or key by train conductor would give him the opportunity of applying the brakes on the driving and tender wheels, as well as on the car wheels?

Do not confine your answers to the above leading questions, but, in addition, kindly give any experience, information, statistics or opinions you may have on the general subject of the application of driver brakes to locomotives [either for or against].

On behalf of committee.

H. A. WHITNEY, Inter-Colonial Railway.
J. DAVIS BARNETT, Grand Trunk Railway

Replies to be addressed to J. Davis Barnett, Port Hope, Ontario, Canada.



PLAYER'S LOCOMOTIVE ASH-PAN.

THE engravings illustrate a new design of locomotive ash-pan got out by Mr. John Player, Master Mechanic of the Central Iowa Railroad, and applied to several of the engines belonging to the road. The general outlines of the ash-pan are so clearly shown in the cuts that little description is necessary. It is a self-dumping ash-pan, with slats that open to permit the cinders to fall through and then close tight. The whole of the ash-pan is of cast iron, and adds considerable weight to the engine at a point where weight can be best utilized. Compared to ordinary ash-pans, this one is cheap and very durable. There is no patent on the device, and Mr. Player will, no doubt, give any master mechanic wishing to try an ash-pan of this kind full particulars about it.

Recollections of a Retired Master Mechanic.

BY A. F. THOMAS.

IDIOSYNCRACIES OF LOCOMOTIVE ENGINEERS. RIGHTS. IMAGINARY LOCOMOTIVE DEFECTS. CHANGING PISTON-PACKING.

Locomotive engineers are a very respectable class of men, but their calling and their surroundings develop peculiarities of character that make them a difficult class of men to handle. The locomotive engineer of America inherits a great many of the high qualities and silly weaknesses of the old stage coach driver. He is generally self-reliant, patient and full of expedients in working his train along under difficult circumstances, but regarding himself as the top of the workman's heap, he is in too many cases self-conceited, arrogant and bull-headed. So soon as he is able to pull the throttle and handle the locomotive, he imagines himself complete master of the whole art and mystery of steam engineering. As he talks incoherently of valves, lap, lead and compression, the admiring wonder of the head brakeman confirms him in the belief that he is wondrous wise in all that pertains to the locomotive. The undisguised amazement of the station operator when listening to his tales of the engine's prowess developed by his own skill, tends to turn the head of a naturally modest man.

When I was first appointed master mechanic of the P. & Q. road, my friends, who wished me to succeed in life, advised me in the first place to secure the good will of the engineers. It might, they said, be unfortunate for me if I did not work harmoniously along with the superintendent. I might, they averred, be likely lose my position if I did not act in perfect accord with the wishes of the general manager, but if I did not retain the co-operation and good will of the engineers, my friends assured me that I would lose my job and my reputation both. I found afterwards that they understood the situation pretty well. That was a good many years ago, but I believe the influences potent on the P. & Q. in that day are by no means weak on many lines to-day. Although young in those days, I was suspectible to advice and resolved to go slow. When I took hold I found things in bad shape, and I was anxious to make reforms, but discretion said be easy or your period of reformation will be brief.

A very short time in harness showed me that although the engine men had practically their own way, they were not satisfied. From the youngest fireman to the oldest engineer on the road, there was a continual conflict about contending rights. To judge from the wranglings, claims counter-claims and complaints that were incessantly dinned into my ears, one would have concluded that the company or its officers had no rights or authority whatever, and that the road was run entirely for the benefit, pleasure and maintenance of the engineers and firemen. Every man was anxious to have the best runs, and as the value of runs varied with the season's work, a man who had a good run one month was dissatisfied with it the next. The rule had been for the oldest man to have his choice of engines or runs, and I did not alter it. The company had made no stand previously on selecting men because of their fitness for runs, and I was not prepared to sacrifice myself in making the innovation, for I had a wife and six children to support.

One innovation I insisted on among the men, however, and it was vigorously resisted. The oldest engineers claimed their choice of engines and runs, and so did the oldest firemen; but the engineers claimed the right to take the firemen they preferred. I made the rule that the oldest fireman had the same rights as the oldest engineer. It proved an apple of discord, but the men got leave to fight it out together. They did fight, too.

There was very little loss caused to the company by the men dictating who should run particular engines or trains, but I soon discovered that the men were in the habit of controlling the repair work. While they were permitted to say what work should or should not be done, I knew it would be impossible for me to make an economical record in the shops. I resolved to make a change in the practice.

A great many engineers become cranks about the needs of their engines, and if their orders about repairs be implicitly attended to, a great deal of unnecessary work will be done. That was the case on the P. & Q. One man was touchy on pumps. His pump never worked just right. It was either drowning the boiler, or the engine was running away from the pump, and the engine never spent a day in the shop without some change being made on the pumps. The next man was troubled with his boxes. There was always a pound in his boxes, and he was continually having machinists trying to cure a trouble which existed only in the man's imagination. Another man suffered from his rods. There was always something the matter with them, and he was right in the main, but the real trouble was that he could not let well enough alone. To go over the list of each engineer's favorite trouble would make a long story.

The road had used from time immemorial common spring piston packing, and it seemed as if all the engineers imagined that their packing should be set out every time their engine was three hours in the roundhouse. The expense for piston work was enormous, and I determined to end it by employing steam packing in the form plain cast iron rings.

There was an old engineer on the road named George Mason, who was justly regarded as one of the best runners on the road, but he was violently tortured by a chronic belief that his piston packing was blowing. I resolved to give him the first set of the new packing.

On mentioning to him what I intended doing, he was very indignant, indeed, and guessed he was not going to have his engine ruined by any such nonsense. That was precisely the way he spoke. I did not get mad, as I had good cause to do, but reasoned with him that the new packing did very well on other roads, and I felt assured that he would like it if he once had a trial of it. So the new packing was put into the 66, and George took out his train but got nowhere, and came in next day with three cars short of a full train.

I asked what the matter was, and was told it was that new packing. The engine blowed through so badly that she would not pull the full train. I had the cylinder heads taken off and the packing examined, and, as I expected, it looked in perfect order. Next day, when George was ready to go out, I went on the engine and rode out with him ten miles. The engine was working as well as George would permit her, but he was nervous, and kept saying he could hear the steam blowing through, and on this account he could not do the engine justice. He believed the engine was working badly and that she would lose time, and his belief contributed to bring about delay. As I expected, he returned late with a reduced train.

I felt assured that the man was trying to do his best, but he had made up his mind that the packing would no work, and he was unconsciously working against it.

Mason reported to me on his arrival with the old story, so I said to him I would put back the old packing on one condition, and that was, that he should get along by having it examined only once in two weeks. That seemed a long time for George to go without seeing into the cylinders, but I told him I could not keep the work going at the rate packing was being examined, so he consented to run the two weeks. With this agreement made, I walked with George to the roundhouse and gave the foreman, Mr. Power, orders to change the packing. The engineer was so delighted that he waited round till the machinists finished the job, and then went home happy.

In the meantime I told Mr. Power to get reliable men round after night and put the steam packing back into the cylinders of the 66, which was done, and none of the enginemen knew anything about the change.

George Mason got round in the morning, and went out like a man with a burden lifted off his back. The conductor, on seeing the engine, asked if he would lay out two or three cars, but George answered that old 66 was herself again, and could take a full train with the best of them.

The next time I saw him I asked how the engine did now, and he answered "splendidly," and went on with a tirade against steam packing.

When Mason had been running about a week without his packing being examined, which was an unprecedented length of time with him, he came into the roundhouse and told the foreman that she was blowing a little, but he guessed he could make out the two weeks. At the end of next trip, however, he wanted to have the packing examined, but Mr. Power refused to touch it, reminding him of the agreement made with me. Mason came to me then and said he would like the two weeks to begin from that day. He knew the packing was not blowing much, but he was beginning to hear it, and he thought perhaps the steam packing had put the pistons a little out of shape, and felt confident there would be no trouble in getting them to run the two weeks after they were once put just right.

I consented to have the packing examined, and told him to wait and see how it looked. When the machinist got the follower off, the engineer looked at the piston, rubbed his eyes and looked again, then made a rush to the cab for his coat and hurried home.

I directed Mr. Power to have another man ready in the morning to take the engine out if Mason did not get around, but he was there on time and took his train over the road on time also. On returning he came to me with tears in his eyes and protested that he was the worst idiot out of the county lunatic asylum. There never was any more trouble with his packing, and the lesson had a very beneficial effect upon the rest of the engineers. No more objection was made to the steam packing as it was introduced.

THE Lake Shore & Michigan Southern road has recently placed the following orders: 286 freight cars with the Peninsular Car Co., Detroit, and 200 coal and 100 flat cars with the United States Rolling Stock Co., at Hegewisch, Ill.

THE Barney & Smith Manufacturing Co., Dayton, O., are very busy with the following orders: Passenger cars, 2 for Ohio Valley road, 8 for Gulf, Colorado & Santa Fe, 6 for Minneapolis, Lindale & Minnetonka, 10 for Atchison, Topeka & Santa Fe, 13 for Wisconsin Central; also, 4 parlor cars for Chicago & Northwestern, 12 chair cars for Missouri Pacific, 1 private car for Richmond & Danville; 2 sleeping, 2 chair, 3 mail, 3 baggage and 3 milk cars for Wisconsin Central; 2 mail, 4 baggage and 1 pay car for Gulf, Colorado & Santa Fe; 8 sleeping, 4 dining and 1 private car for Canadian Pacific; 1 combination and 4 box cars for Pacific & Great Eastern; also, 400 freight cars for Milwaukee, Lake Shore & Western; 500 box cars for Minnesota & Northwestern; 75 stock and 20 flat cars for San Antonio & Aransas; 570 freight cars for Wisconsin Central; and 20 Arms palace horse cars.

Combustion in Locomotive Fire-Boxes.

BY ANGUS SINCLAIR.

Fifth Article.

THERMAL VALUE OF DIFFERENT COALS.

Coal that contains a heating power equal to pure carbon will, in properly designed furnaces, evaporate from 10 to 13 pounds of water to the pound of coal consumed. Some English locomotives are reported as evaporating 12 or 13 pounds of water and upward to the pound of coal, but it is doubtful if there is a single locomotive on the American continent taking this high duty out of the coal. This may be due to structural imperfections, but on the other hand the high duty of other locomotives may to some extent be due to the kindness toward their own engines of the engineers overlooking the tests. Seven pounds of water evaporated from ordinary feed temperature, or equivalent to eight pounds evaporated from and at 212° Fahr., is about the best duty per pound of coal we have met with among American locomotives. The roads, however, that are getting this high efficiency are few and far between. Six pounds of water evaporated from feed temperature is quite a common performance, and locomotives are in many instances designed and proportioned with the understanding that about six pounds of water shall be evaporated for every pound of coal burned.

When a locomotive is designed with ample heating surface for the cylinder capacity, she is certain to steam freely unless prevented from doing so by faults not inherent to the engine. When, on the other hand, a locomotive is known as a bad steamer, or a great waster of coal, it may be safely presumed that the cylinders are too large for the boiler. An engine with heating surface just right for one locality may have too little heating surface for another place, owing to the different heating value of the coal. This is no doubt the reason why many locomotives in Western States have such an unenviable reputation for wasting coal. By experiments made some years ago by Mr. E. T. Jeffrey, now general manager of the Illinois Central Railroad, it was shown that the evaporative capacity of different coal used by the road varied from 3.77 pounds of water for 1 pound of Fort Dodge coal, to 6.32 pounds of water for 1 pound of Carbondale coal. The average thermal value of coal taken from sixteen different coal fields was 5 pounds of water evaporated to the pound of coal.

EFFECT OF USING BAD COAL WITH INADEQUATE HEATING SURFACE.

Suppose an engine has to take a train over a division 100 miles long at the rate of 35 miles an hour, or 172 minutes running time, and can generate sufficient steam for doing the work by evaporating 147 pounds of water per minute. This is a common performance, and in case our engine is supplied with coal equal in thermal value to the Carbondale product, the work will be done on a consumption of 23.256 pounds per minute, or 40 pounds per train mile. If the engine, however, should be supplied with Fort Dodge coal or its equivalent, the heat obtained from 67 per cent. more coal must be got to make the required steam, or 39 pounds must be burned per minute under the most favorable circumstances. In the case of coal with 5 to 1 evaporative capacity being used, 29.4 pounds per minute would have to be consumed, representing an increase of 26 per cent. over the Carbondale coal. Very few locomotives are equal to the task of burning inferior coal as economically as they can use good coal. Where inferior coal has to be burned in locomotives deficient in heating surface, means for augmenting the rapidity of combustion have to be resorted to, that the required steam may be generated. The means used to produce this effect also greatly increase the rapidity of the gases passing from the fire to the atmosphere, so that less time is provided for the heating surface to absorb the heat from a given volume of the products of combustion. Owing to this, considerably more coal than the quantity represented by the difference in thermal value between a good and bad quality of coal has to be burned when inferior coal is used for locomotive fuel.

VALUE OF FIRE-BOX AND TUBES AS HEATING SURFACE.

The fire-box sheets of a locomotive are without doubt the most efficient part of the heating surface, but the heating surface of the tubes is much more valuable than many people are willing to admit. We are continually hearing reports about how little value the tube surface of locomotives is for evaporative purposes, but many of the conclusions to this effect are arrived at by means reflecting no credit on the accuracy or tendency toward research of the men making them. One man finds that through carelessness a great many tubes of an engine got choked up, and it made no perceptible difference to her steaming, and she did not appear to burn more coal than when the flues were all open. Another finds that the front end of the boiler gets filled up with lime and mud after the engine has been running some months, and that it does not make any difference to the steam-making capacity of the engine. Still another man, instead of piecing tubes where they have to be taken out of a boiler, cuts off the ends and puts the front flue sheet back far enough to make the tubes fit, and fails to see that the boiler steams less freely from the change. Conclusions arrived at by these methods are not demonstrations of facts founded on accurate tests. They are opinions formed on prejudiced guessing, that has been the bane and reproach of American locomotive engineering.

An engine may steam as well with twenty or thirty of the tubes stopped up as she did when they were clear, but the gases in the smoke-box will certainly have a higher temperature. The manner in which coal records are ordinarily kept does not provide a check in the performance sheet of any value for a designer to be guided by. Unless a master mechanic is prepared to make accurate experiments to ascertain the effect of any change made on his engines, he had better make no changes. It is owing to the prevailing practice of wild guessing in place of experimenting, that numerous patented inventions successively brought out for locomotives have been pronounced wonderful improvements and heralded to the railroad world as such, although they did not possess sufficient merit to keep them six months on any engine.

The locomotives in America, as elsewhere, that are doing their work most economically, are those provided with the greatest heating surface in proportion to their cylinder capacity. The engines that are costing most for fuel and repairs are those designed on the principle that flue surface is of little value, and those that have cylinders much too large for the weight carried on the driving wheels. The master mechanic of a prominent road once got seized with the belief that so long as an engine had a good large fire-box, the number and length of flues was of little consequence. He built an engine to prove his theory, and on trial found it suited him. Then he had a large number of the engines made after that design. The engines are recognized all round to-day as a most expensive monument of the designer's folly.

GRATE AREA.

What is the proper proportion of grate area for the heating surface of a locomotive boiler does not appear to have been demonstrated by experiment. The well-known engineer D. K. Clark maintains that "there may be too much grate area for economical evaporation, but there cannot be too little, so long as the required rate of combustion per square foot does not exceed the limits imposed by physical conditions." In ordinary locomotive practice, when the engine is working hard, it is an advantage to have very large grate area; but when the engine is working light, the large grate area is a disadvantage. Some years ago Mr. John E. Martin, master mechanic of the Chilian & Talcuhuano Railway, of Chili, made a most exhaustive series experiments with the use of dead grates, in which he obtained material advantage from closing up part of the grate openings by dead-plates. In certain cases he claimed as high as 15 per cent. saving of fuel. His rate of coal combustion was, however, so low that few locomotives in this country are worked under parallel conditions; but it is probable that, on many of our roads, a saving could be effected by the judicious use of dead plates, were proper means provided to supply air above the fire, and to regulate the air passing in below.

BRICK ARCHES.

In the history of American railroad mechanical engineering there is nothing more curious than the conflicting opinions made public respecting the value of brick arches in locomotive fire-boxes, and the value of providing means for supplying air above the fire. In Europe, where much greater attention has been devoted to the economical combustion of coal in locomotive fire-boxes than among us, nearly every conceivable device calculated to promote economy has been tried, and locomotive superintendents have settled down to a fire-box having a brick arch or water table, and some simply means of providing air above the fire. They are also very careful to have dampers that can be easily operated to regulate the admission of air below the fire. When a brick arch falls down the engine driver would no more think of making a trip without it, than he would think of running without the fire-door. We venture to say that the combination of a good brick arch, means of admitting air above the fire, and means of restraining it below when necessary, would be as popular in this country as it is abroad, and would give as good results with soft coal burning locomotives, if it were intelligently and fairly handled.

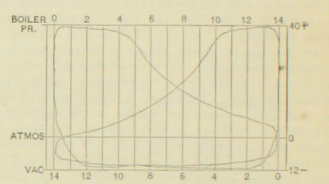
With a plain fire-box the passage of the gases formed in the forward part of the fire is so short before they reach the tubes, that insufficient time is given for combination. A brick arch, or its equivalent, compels the gases from the front of the fire to travel farther before they reach the tubes, protracting the time they remain inside the fire-box. The obstruction that the brick arch offers to the direct passage of the fire gases into the tubes also has a tendency to make the gases mix and enter into combination. It is well known that the gases that go to form combustion mix very slowly when placed quiescently together in a vessel, and it is probable that the agitation within the fire-box, caused by the gases rebounding off the brick arch, prevents the currents of air and of carbureted hydrogen from passing over in parallel layers, as they are apt to do when left to follow their own course toward the tubes. The high heat of the brick also helps to maintain the portion of the fire-box where chemical combination is going on rapidly up to the igniting point, and so equalizes the heat at a part where momentary reduction of temperature would cause serious waste of fuel. The best managed railroads in this country are using brick arches.

HOLLOW STAY-BOLTS.

Very little is being done to provide air above the fire. Ten years ago hollow stay-bolts began to be very popular, and their use was strongly recommended in a report made at the meeting of the Master Mechanics' Association in 1876. Some master mechanics were using as much as twelve square inches of opening above the fire. That was carrying a good thing rather too far, and undoubtedly killed the popularity of hollow stay-bolts. An engine working hard with a heavy train would derive benefit from the air passing through large area of openings above the fire, but as soon as the engine began to work light the large quantity of air above the fire would have a tendency to reduce the temperature of the fire-box, and so waste heat. This would be intensified by the absence or neglect of means for closing the admission of air from below the fire. As the ordinary American fireman pays no attention whatever to dampers, except to open them all in starting, the admission of air above the fire must necessarily be very limited till some successful missionary work is exerted on the enginemen. On exceptional roads, where the firemen are trained to operate the dampers, and properly made dampers are provided for regulating the admission of air, bituminous coal is burned very economically, with almost entire absence of smoke. The most gas-producing of bituminous coal can be burned in locomotive fire-boxes to utilize the greater part of the volatile compounds for heat making, and it can be done without raising a smoke nuisance, but mere mechanical appliances alone will not suffice. Care, intelligence and skill must exercise control.

Large Single Cylinder Engine.

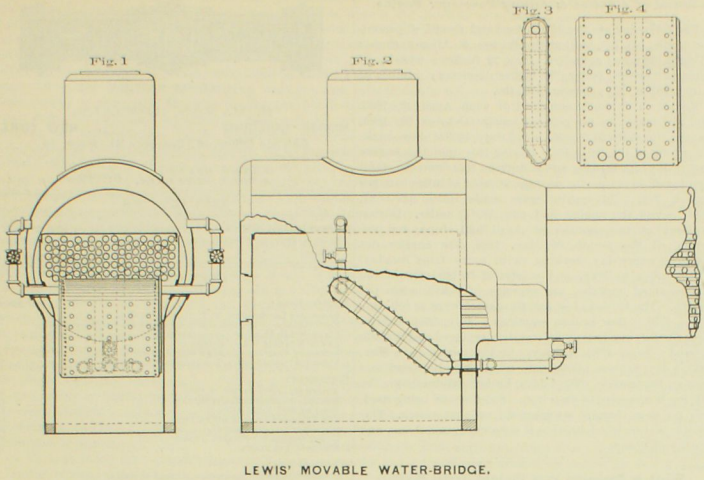
The accompanying diagram is taken from the engine of a steamboat belonging to the Central Pacific Railway Company. Mr. A. J. Stevens, General Master Mechanic of the road, writes us as follows:



"The engine from which the indicator card sent you was taken is a low pressure, jet condenser, inclined engine, fitted with a Stevens cut-off poppet valve, the same as is usually used on vertical or beam engines. Cylinder 57 inches diameter, stroke of piston fourteen feet. The 'Piedmont' is a passenger ferry-boat plying between Oakland and San Francisco, and registers about 2,000 tons. Average daily run, 112 miles. This engine was built in our shops here at Sacramento, and has now been running about twenty-six months. Fuel used under the boilers of this engine is petroleum; consumption nineteen hundredths of one gallon per hour per indicated horse-power. It works very well and costs considerable less than coal. Evaporation 10.9 gallons of water to one gallon of oil burned."

THE St. Charles Car Manufacturing Co. has just received orders from the Atchison, Topeka & Santa Fe road to build 250 coal, 200 stock, 250 flat, 100 box and twelve caboose cars. This, with the repairing of cars on hand, will keep them running steadily all winter.

WE recently saw some specimens of Shoenberger fire-box steel subjected to very severe physical tests, which they passed through without showing any signs of distress. A specimen $\frac{5}{8}$ inch thick and 3×8 inches, had a $\frac{3}{4}$ inch hole punched in the middle, then the hole was drifted till it was $1\frac{1}{2}$ inch wide, and no cracking resulted. The piece was then folded lengthwise under the steam hammer, and afterwards folded across, each fold being hammered down hard. All this was done cold. These tests were made at the Illinois Central Railroad shops. We saw a specimen subjected to similar treatment at the Chicago & Northwestern Railway shops, but the foreman boiler maker there gave it a test of his own, which he alleges is the most certain test for the quality of fire-box plate. He cut a thin strip off the specimen, and when cold hammered the end out flat. This specimen showed not the slightest tendency to crack under that test. The foreman said that he seldom found steel that would pass that test without cracking a little. The Shoenberger steel is, we understand, making rapid progress into favor as fire-box steel for locomotives. Wherever it has been used once, increased orders have followed, which is a good sign for any material. The natural gas which the makers use as fuel, enables them to turn out a steel particularly free from the impurities that lead to cracking.



LEWIS' MOVABLE WATER-BRIDGE.

The device illustrated in the accompanying engravings is the invention of Mr. W. H. Lewis, Master Mechanic of the New York, Chicago & St. Louis Railway, at Englewood, Ill., and is in successful operation in several of the locomotives belonging to the road the inventor is connected with. There is little diversity of opinion among master mechanics who have had the opportunity of judging by experience as to the economy of fuel resulting from the use of a water-bridge in the fire-boxes of locomotives, but the fatal objection to these devices has been that they burn out readily where bad water is used, and the services of the engine is lost while the water-bridge is being replaced or removed. In the invention we illustrate, Mr. Lewis has overcome the leading objection to the use of the water-bridge, by making it detached from the sheets of the fire-box. The method of construction is so obvious from an inspection of the engravings that little description is necessary. In form the water-bridge closely resembles the brick arch that is so well known, and its position in the fire-box is about the same. This bridge is, however, made of iron or steel sheet, and is hollow, the inside forming a water chamber. The bridge is supported by pipes which provide means for the free circulation of the water, and also for closing off communication with the boiler should a leak break out in the water-bridge or its connections. The bridge is constructed and fastened in such shape that it can be removed and replaced in a few hours. Where the bridge comes to be used as an ordinary part of the fire-box, new bridges could be kept in stock, and making a change would not require much more labor than putting in a new set of grates. Mr. Lewis also proposes using pipes through the middle of the bridge to convey air from the atmosphere to the inside of the fire-box.

Noah Webster's Locomotive.

Webster's Unabridged Dictionary is the friend, companion and mentor of a large proportion of America's thinking population, and a very wise book it is and wonderfully near perfect. If there is any special bias the book has, it is towards the practical American way of spelling and defining, but when it comes to tell about the locomotive engine by means of illustration, it is ridiculously un-American. Among the plates at the end of the book there is a machine marked "Locomotive Steam Engine," with parts named. This begins as clearly as the description of Artemus Ward's horse that had four legs, one at each corner, and it is fortunate the publishers en er so closely into details, otherwise the ordinary American citizen would hardly recognize the cut as that of a locomotive, for there certainly never was a locomotive like it seen running on the American continent. Men familiar with early British locomotive engineering will recognize in the figure the Crampton locomotive, which had a brief popularity in Europe, but is seen no more, except on a few French minor roads.

The engine has a single pair of driving wheels which are of immense size, and are placed behind the fire-box. Two pairs of small wheels carry the forward part of the engine, and they receive the weight by axle-boxes working in pedestals on the main frame. The cylinders rest on top of the frame and near the middle of the boiler, outside pipes conveying the steam from the dome to the cylinders, and from the cylinders to the smoke-box. The eccentrics are placed outside the driving wheels. The smoke-stack has a door for shutting off the draft. The names of parts, given to the various details of the engine sound curious to people accustomed to the names used in this country. The main rod is called the crank rod, the valve stem is the slide rod, the steam chest is the slide valve box, the dome is the steam box, the exhaust pipe is the eduction pipe, the ash-pan is the cinder-box, and the driving wheel is denominated the fly wheel. We are afraid some wag imposed the cut of the Crampton locomotive upon Noah Webster by way of a joke, but how the legicographer did not miss the cow-catcher and spark arrester is as much of a mystery as how the book ever came to pass through so many editions without that cut being turned out.

MR. GEORGE ROYAL, traveling agent for the Nathan Manufacturing Company, says that an item which appeared in the NATIONAL CAR-BUILDER of last July about sight feeding oil cups on the Chicago & Northwestern Railway has attracted much attention among master mechanics, and has prevented several from increasing the weight of their eccentric rods. He tells of a case where a master mechanic had experienced great annoyance from the eccentric rods of a Mogul engine breaking, and he had made up his mind to remodel the valve motion when he saw the paragraph mentioning how the Chicago & Northwestern engines were cured of the same malady by the application of continuous lubricators. He tried the same remedy and found it effectual.

SOME years ago, when it was proposed to substitute the Wagner for the Pullman sleepers on the Iron Mountain Road, an injunction was obtained forbidding it, on the ground that, as the Missouri Pacific was identical with the Iron Mountain and had contracted to use only Pullman cars it must keep them on its controlled road. The Supreme Court of the United States holds that the mere ownership of the stock of the Iron Mountain does not make that road and the Missouri Pacific one, but that, for all practical and legal purposes, they are separate concerns. —*Railway Register.*

LOCOMOTIVES have been increased in weight and size so much during the last twenty years, to keep pace with the demand for pulling heavy trains, that many master mechanics have been put to great inconvenience in providing house room for them. All sorts of makeshifts have been resorted to in order to get the engines inside the short roundhouses. The inconvenience that American roads suffer from the increase in the length of locomotives appears, however, to be trifling in comparison to the inconvenience arising from the same cause in older countries. Mr. Stroudley, locomotive superintendent of the London, Brighton & South Coast Railway, in England, explained that his reason for designing locomotives without trucks was, that the trucks lengthened the engines so much that they could not be turned on the tables of the road, and that at some places expensive property would have to be pulled down to make room for larger turn-tables.

THE official report of the proceedings of the convention of the Master Car-Builders' Association, held at Old Point Comfort in June last, has just been published. It is uniform in size and style with the recent previous reports, and contains the discussions, reports of committees, etc.; also results of letter-ballots, minutes of Executive Committee, standards adopted by the Association, rules of interchange, constitution and by-laws, and list of committees and subjects to be reported upon at the convention to be held at Niagara Falls next June. Among the illustrati are the Christie and Collin brake shoes and heads.

Tests of Automatic Car Couplers.

The Executive Committee of the Master Car-Builders' Association have issued the following circular in reference to the trials in service of the couplers selected at Buffalo in September last:

The Executive Committee of the Master Car-Builders' Association held a public trial of automatic car couplers at Buffalo last September, and they selected twelve of the number submitted to be put in service, to the extent of ten cars each, during the coming winter. A sub-committee was then appointed to arrange the details of these trials in service, and this committee is now perfecting arrangements to have ten line cars, which pass over trunk lines, equipped with each of the twelve couplers selected, and they hope to have them all in service by December 1.

Each car equipped with these trial couplers will have the following stenciled plainly on each side of the car near one end:

"M. C. B. test.....coupler"

(the name of the coupler on each car being used in the space here left blank), and when the couplers are all in service an additional list will be issued, giving specifically the numbering and lettering on each car equipped with each coupler. In the meantime the stenciling placed upon the cars will serve to identify them. It is desired that these couplers be kept up and remain in active service until May 1, 1886, and a full and detailed report of the cost of all repairs, as well as of the working, or the failure to work safely, of these couplers will be looked for from all members of the association who are connected with any railroads over which any of these couplers may pass up to that date.

Members of the association are earnestly requested to see that all car inspectors and foremen of repair shops, as well as train men, on the lines with which they are connected, have proper instructions in this matter, and that reports should be made at such a date as will enable members to forward their reports to the Secretary in New York not later than May 10, 1886.

By placing the couplers for trial on line cars, it is thought that reports may be had from the same source on a number of different couplers, and in order to make the style of such report more uniform and easy for tabulation, we give the points which it is especially desired to have information upon while the cars are on your line.

1. The nature and cost of repairs to couplers on each car receiving such repairs, by car number and name of coupler.

2. State whether there has been any failure of any coupler to couple automatically with its own kind, specifying what couplers have so failed, and in how many instances and the cause.

3. State whether any of the couplers have automatically uncoupled when in service on your line, specifying what couplers have so behaved, with the number of such occurrences for each coupler, and with cause and circumstances.

4. Give opinion of train men as to the comparative safety in coupling and uncoupling each style of coupler which has passed over your line when coupled with one of its own kind.

5. Give opinion of your train men as to the comparative safety or danger involved in coupling each of the couplers which have passed over your line with the ordinary draw-head, as compared to coupling two ordinary draw-heads together.

6. Give any further information of importance on points not included in the foregoing, which may have been noticed with regard to any of the couplers which have passed over your line.

By order of the Executive Committee,

November 20, 1885. M. N. FORNEY, Secretary.

Central Vermont Railroad Locomotives.

In answer to a letter of inquiry, Mr. W. J. Robertson, superintendent of motive power of the Central Vermont Railroad, writes us:

I cannot say that I have carried out any special improvement, otherwise than what I call the best practice. In a few cases I have put on an extension arch of 18 inch in lieu of 30 inch, as is usual with most builders, and as far as economy is concerned it does equally as well. One other point. I use a 16 inch straight stack on cylinders ranging from 15 to 18 inch diameter. I mention this simply because the old masters have advocated the stack should be the same diameter as the cylinder on the engine.

I would also mention that I am discarding the circulating pipes in fire-boxes. I think it is an expense we can get along without, and we can support the brick some other way. I have every confidence in the fire-box brick either with or without the extended arch. Referring to the last part of your letter, I am building a passenger engine 18 × 24 cylinder, wheel 5½ feet, 52 inch boiler, 72 inch box, 200 two-inch tubes, sheet ⅜ steel and other sheets in proportion. The engine is designed for heavy traffic. Driving axles, 8 × 8 inch journals, heavy bar frame. I use gun metal slides, cast steel cross-heads and gun metal links for valve motion.

Southern Pacific Railway Locomotives.

In answer to a letter of inquiry, Mr. A. J. Stevens, General Master Mechanic of the Pacific system, writes from Sacramento, Cal.:

We built (rather rebuilt) but two locomotives during the year 1885. One with cylinders seventeen inches in diameter and thirty inches stroke of piston; six wheels coupled, four wheel truck forward; driving wheels four feet six inches; the other engine with cylinders eighteen inches in diameter and thirty inches stroke of piston; driving wheels four feet six inches in diameter; six wheels coupled, four wheel truck forward. Both engines equipped with the Stevens valve gear. The former weighs forty-three and the latter forty-five tons. These engines are intended for service on our mountain roads—grades from forty to one hundred and sixteen feet to the mile. Both engines are wood-burners. We are rebuilding two more engines, cylinders to be seventeen inches in diameter and twenty-six inches stroke of piston, driving wheels five feet six inches. The boilers of these engines were made of steel, calculated to carry 145 lbs. steam as a working pressure. The boilers are straight top; fire-boxes have arched crowns stayed with screwed stay-bolts; shell of boiler fifty-four inches in diameter, containing 190 two and one-quarter inch tubes, eleven feet six inches long; grate surface, nineteen square feet.

The Proposed Freight Brake Tests.

AURORA, Ill., Dec. 7, 1885.

To the Editors of the National Car-Builder:

The proposed brake test which was to have been held at Burlington, Ia., Dec. 14, will not take place, the required number of competitors having failed to respond.

A meeting of the committee will be held at Harrisburg, Pa., Jan. 6, 1886, at the Lochiel Hotel. Action will be taken on the correspondence that has grown out of the committee's proposed trial. It is expected a modification can be agreed upon that will be satisfactory to both the owners of brakes and the committee.

G. W. RHODES,
Chairman Automatic Freight Brake Committee.

English Locomotives No Better Than Our Own.

Mr. E. T. Jeffrey, General Manager of the Illinois Central Railroad, spent last summer in Europe, and he devoted close attention to railway machinery and the methods of operating. Few American railroad travelers are so well able to make fair comparisons of foreign machinery and methods of operating as Mr. Jeffrey, for he passed up through the mechanical department to his present position. At one time Mr. Jeffrey held the distinction of being considered the best authority on locomotive valve motion among the master mechanics of America. We recently had a conversation with Mr. Jeffrey about his travels, and learned his impressions about English locomotives. He said that an English locomotive, coupled to an American train of cars on any of our railroads, would not make a record for economy much superior to our own engines. They do their work economically, but it is principally due to care in handling, care in firing, large boilers in proportion to the cylinders, and light trains. Where American designers work in the line followed by English locomotive designers for years, we get out engines capable of using steam as economically as any locomotive he had seen abroad. Our men are not so well trained to save coal and steam as English enginemen are, but great improvements are being made among us in this respect. Mr. Jeffrey visited the great works of the London & Northwestern Railway at Crewe, and examined Mr. Webb's compound locomotives minutely, and closely watched the way they behaved in the operation of trains. He admires Mr. Webb's mechanical productions, but does not think the compound locomotive would make an economical record if introduced into this country.

Secretary Setchel on Improvements in Locomotives

In the course of a private letter to one of the editors of this paper, Mr. J. H. Setchel, Secretary of the Master Mechanics Association, says:

"By the way, I see I am quoted in the *American Journal of Railway Appliances*, as saying there would be no improvements in locomotives in the next ten years. I wish you would contradict this most emphatically, as it is not my position and I did not say anything that I intended should be construed in that way.

"What I did really say was this: A question was asked, 'Will there be any improvements in locomotives within the next ten years that will reduce the cost of transportation or materially increase the speed of trains?' to which I replied that there was nothing in sight and I did not think there would be unless in the application of appliances for the saving of fuel; that fuel was about 33 per cent. of the cost of running locomotives, and from the wasteful manner in which it was used on our locomotives and the little attention that was paid to it by railroad officials, there was more room in that quarter than in any other for improvement. If the Wootten engine could be made to burn the slack and poor coal found on many of our western and southern roads, as successfully as claimed for it, that would seem to be a step in the right direction, as it would save largely in first cost as well as in the transportation of fuel. As to the speed of trains, I thought that if the permanent way of our through lines could be made as perfect as some portions of them now are, any of our modern engines would be able to make as fast time as the public would demand.

"I have always been an earnest advocate for improvements, not only in the locomotive, but in all railroad appliances, and the position of the Master Mechanics' Association is one of rigid investigation in all mechanical matters pertaining to railroads, and they have and will always give a hearty support to the 'survival of the fittest.'

"I am opposed to writing any cards, and do not intend to do so now, but simply give you this information that you may have an opportunity to place the Master Mechanics' Association and myself right in this matter."

MR. STROUDLEY, locomotive superintendent of the London, Brighton & South Coast Railway, adopted an axle very similar in all respects to the Master Car-Builders' standard. In the course of a discussion at the Institute of Mechanical Engineers, he said, speaking of this axle: The specimen of carriage axle exhibited would fit any carriage or wagon that he had constructed at Brighton during the last fifteen years. He had suggested twenty years ago that a carriage or wagon axle broke in consequence of its being made weakest by notching at the point of greatest strain. He was of opinion that the greatest strain occurred at the inner end of the wheel boss, and it was necessary to make the axle strongest at that point, and it was from neglect of this precaution that the carriage and wagon axles broke more than from any other cause. That was why he had ventured to make the axles in the form he had adopted. He had made them of this form ever since, and none of them had broken.

THE increase of sizes of the different parts of locomotives and cars has gone on slowly but surely ever since Peter Cooper's Tom Thumb locomotive made its first trip on the Baltimore & Ohio Railroad. In many cases the increase of size and weight has been bitterly opposed by railroad officers of great influence. When Samuel J. Hayes, afterwards so well known from his connection with the Illinois Central Railroad, took charge of the mechanical department of the Baltimore & Ohio Railroad in 1852, they were using car-axles 2¼x4½ inches. Perceiving the tendency of mechanical progress, Mr. Hayes recommended to the general superintendent that a journal three inches diameter by six inches long, should be adopted. The superintendent consulted with the president about the proposal, and that officer emphatically objected, and exclaimed, "That man Hayes will ruin the road if you let him go on."

Record of a Boston & Albany Passenger Engine.

The following are the dimensions and record of passenger engine No. 137, built at the Boston & Albany shops: Weight, 42 tons; cylinders, 18 × 22 inches; wheels, 68 inches diameter; boiler, 52 inches diameter; number of 2-inch tubes, 221; pressure, 160 lbs.

Record: This engine came out of shop April 23, 1883, and was taken in for general repairs October 30, 1885, having run daily 30 months and 7 days, or 921 days, making a total of 184,726 miles. During this time the engine lost 12 days for repairs, and deducting this from the total number of days run, the average number of miles run per day is 203. No repairs were made until April 27, 1884, when the engine had run 78,812 miles. During portions of the months of April and June, and the whole of the month of May, 1885, the engine ran 400 miles every day, making (with extra trips Sunday) 10,910 miles in May, and a total of 26,740 miles in the above-named months, an average of 8,913 miles per month. The 12 days lost and the causes were as follows: April, 1884, 1 day, broken equalizer; July, 1884, 4 days, tires turned, one broken driving-box replaced and throttle ground; July, 1884, 4½ days, broken piston-rod; May, 1855, ½ day, broken piston-rod, front cylinder head and casing; September, 1885, 2 days, broken driving-box. The driving-boxes were of cast iron. Steel is now being used, and no more trouble is expected from that source. This record is furnished because it is an exceptional one, and worthy of notice.

What is Essential in a Freight Train Brake.

Mr. Wm. P. Shinn, in his paper on the subject read before the American Society of Civil Engineers, enumerates the following conditions as being essential to the successful working of a freight car power brake:

1. It must be a detached brake.
2. It should be as automatic as possible; that is, under as many conditions as possible.
3. It should require no application of the hand at each car by turning a lever or pulling a cord, to set it in action or to release it after action; nor would a brake be satisfactory that requires reversing in order to make it apply when the cars are running in opposite directions.
4. It should be prompt in action.
5. It must be prompt in releasing when the train comes to a stop.
6. It must not slide the wheels, as flattened wheels are a serious cause of expense.
7. It should come into action without regard to the position in the train of the car or cars to which it is applied.
8. It should act when necessary without the volition of the engineer, so that when the cars to which it is applied are on a foreign road it will be applied by the ordinary action of the engineer, whether or not he knows of its presence in the train.
9. It should be simple in construction, reasonable in cost and economical in maintenance.

Mr. Shinn then says that the "American" brake meets these conditions far better than he had reason to believe before making the tests. He was previously not favorably inclined to a buffer brake, as he did not think it would prove of sufficient value in practice to warrant its adoption, but he was now convinced that a properly constructed buffer brake is a great addition to the freight equipment of a railroad.

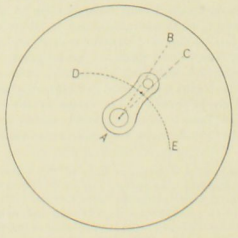
Locomotives Built at Susquehanna.

At the Susquehanna shops of the New York, Lake Erie & Western road, 33 locomotives were built during the year 1885. Of these, 6 were passenger moguls and 27 were consolidation engines. The principal dimensions are:

	Passenger moguls.	Consolidation.
Cylinders	20 in. × 24 in.	20 in. × 24 in.
Driving wheels	68 in. dia.	50 in. dia.
Total weight	97,000 lbs.	100,000 lbs.
Weight on drivers	84,000 lbs.	87,500 lbs.
Grate surface	27 sq. ft.	28 sq. ft.
Heating surface	1,140 sq. ft.	1,320 sq. ft.
Number of flues	168	200
Diameter of flues	2 in.	2 in.
Length of flues	1395/8 in.	136 in.
Capacity of tank	3,200 galls.	2,700 galls.

Method of Traming Consolidation Locomotive Crank-Pins.

Considerable difficulty is experienced in machine shops and roundhouses in traming the crank-pins of consolidation and other many-wheeled locomotives To overcome the difficulty Mr. Frank Charles, a bright Cedar Rapids machinist, proposed and practices the method illustrated



in the annexed sketch. The lines *A B*, *A C*, are drawn on each wheel with a straight edge laid against the collar of the pin. From the centre *A*, the arc *D E* is struck with dividers and the centre point between the lines found, which coincides with the center of the pin.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts and money orders made payable, to* THE NATIONAL CAR-BUILDER. *Communications for the attention of the Editor should be addressed* EDITOR NATIONAL CAR-BUILDER.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR-BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

AMERICAN LOCOMOTIVES OF 1885.

During the year 1885 there were fewer locomotives built in the United States and Canada than in any year since 1880. By correspondence with locomotive builders and the leading master mechanics, we have obtained a fair approximation of the number of engines built throughout the country, although there was very great reluctance displayed in many quarters to reveal the limited extent of production. Seven of the leading builders sold 616 locomotives during the year, and it is a liberal estimate to credit the builders who declined to let their production be known, and the various railroad shops, with with 200 more locomotives. This would bring the full list to about 800. Of the engines built, 83 were for export, leaving about 717 to supply the home demand. Two years ago, the seven builders that turned out 616 locomotives this year, built 1,346 engines, and the trade was beginning to grow depressed then. But that year 282 locomotives were exported from the United States, the whole being valued at nearly three millions of dollars. The condition of matters abroad that reduced our exports to their present dimensions, indicates serious depression in foreign railroads as well as among our own.

The intense depression in our locomotive building has not been caused by the railroads being overstocked with motive power, for many of the roads are very much in want of engines, and the managers only refrain from buying new ones because it is possible to get along a few weeks or months longer before the outlay is imperative. This is not good management, for the work is now done with worn out machinery at increased expense, and the renewals will be delayed till the prices of locomotives begin to advance rapidly, when the orders will help to bring about another period of fancy prices. The practice followed by so many railroad managers, of permitting their machinery to go without renewal or proper maintenance during times of business depression, exercises a most injurious influence on the country's industries, for it tends to force business down in dull times, and gives

trade an artificial lift when the reaction comes round. It appears to be the course of natural retribution that the roads which follow the policy indicated should have to pay fancy prices for their machinery when they get ready to buy, and the only cause of regret about that is, that their pernicious policy punishes innocent parties.

There have been remarkably few locomotives built in railroad shops during the last year, and the new work done has been carried on principally to steady the fluctuations of repair work. Considerable attention has been directed to working out improvements on the locomotive. Seasons of depression in the transportation business have always exerted a stimulating effect upon the progress of locomotive improvement. The way in which most of our railroads are operated leaves very little opportunity to work out improvements in machinery when business is active, for the demands of transportation are generally beyond the capacity of the motive power, and all that is thought of is to get the trains moved. But when freight is hard to find, when rates are low and locomotives at a discount, the demand arises for reduced expenses, and attention is directed to the problem of making the locomotive do its work at less expense for fuel and repairs. In many quarters master mechanics are striving to find ways and means for taking more of the heat out of the products of combustion by imparting to the water part of the heat that usually passes into the smoke-stack. Others are working on the problem of taking more work out of the steam as it passes through the cylinders, while many are still engaged working out the simplification of parts that reduces the expense of repairs.

It seems to us that those who are striving to utilize more of the heat produced by the coal, are working in the line of experiment likely to yield the best results. The leading fault found with the American locomotive by its detractors has been that it evaporates two little water for the fuel consumed. The best friends of the engine can hardly say that the accusation is groundless. We have some locomotives evaporating as much water per unit of heat in the fuel, as any locomotive running, but that is not the characteristic of our engines. There is serious waste of fuel going on that ought to be avoided. Various causes contribute to waste of coal by our locomotives. The first cause which ought to be susceptible of the easiest remedy is bad firing. A great deal has been said and written in the last few years about improving the methods of firing our locomotives, but the majority of firemen work on in their own wasteful way undisturbed. So long as the autocrat of the scoop is permitted to laugh the principles of combustion to scorn, the locomotive designer can not produce an engine that will make a good record in economy of fuel. Improvements in the methods of supplying air to the fire will, probably, in many engines produce more efficient combustion of the gases; but the most important and promising line to work on after improving the character of firing, is to find the means of increasing the difference between the fire-box and smoke-box temperature. The smoke-box temperature of our locomotives averages about 200 degrees higher than it ought to do. This represents great loss of heat. The master mechanic who succeeds in reducing the smoke-box temperature of his engines 150 or 200 degrees while maintaining the fire-box temperature will make his work felt on the coal pile.

Our master mechanics who are interesting themselves in taking more work out of the steam, are doing nothing in the way of compounding the locomotive. Our most advanced and enterprising railroad mechanical men have no expectation that a compound locomotive would be successful. In various ways attempts are being made to obtain more expansion of the steam by using improved valve gear, and some of those who have applied this line of improvement to slow working locomotives speak very encouragingly of the results. There are hundreds of locomotives working on our mountain roads that receive no benefit whatever from the expansion of steam. There ought to be no difficulty in effecting material improvements on locomotives doing work of this character. Improving the distribution of steam in a high speed locomotive is a more difficult problem, for some of our best link-motion engines use the steam in a way that leaves little to be improved.

THE PROPOSED FREIGHT BRAKE TESTS.

It will be seen by a notice in another column from the chairman of the Executive Committee of the Master Car-Builders' Association, that the brake tests which the committee proposed making on December 7 have been abandoned, and a call has been made for all interested in the question of continuous brakes for freight trains to meet at Harrisburg on January 7. The tests proposed for December 7 were abandoned because the required number of competitors did not come forward. While it is to be regretted that valuable time has been lost by this failure to agree, it is certain that the free discussion of the subject by parties interested directly in freight car brakes has given the committee valuable information respecting the conditions that are likely to prove acceptable to all concerned. The so-called impracticable nature of the conditions imposed for the Burlington test caused considerable criticism, not to say abuse, of the committee, but there is good reason to believe that they took the right position, since it had the effect of making the owners of continuous brakes indicate clearly the exact conditions necessary to make their brakes work. We do not believe that any of the cavilers at the committee's conditions could devise a set of rules that would satisfy half the brake-owners, even if no attempt were made to be fair towards public and railroad interests.

In devising the terms of tests, the committee had to prescribe rules that would be fair towards contending interests, for each brake company is naturally at odds with its rivals, and in their anxiety to be fair all round they made conditions that were acceptable to none. The committee are now in the position to say to brake owners: "Gentlemen, agree among yourselves on a set of rules that will test all your brakes fairly, and we shall try to make them harmonize with public and railroad companies' interests."

It must soon be decided what continuous brakes are best adapted for freight service, and if the proposed tests are going to mean any thing, they must indicate, not only how well a brake will operate when new and in perfect order, but how well it will operate after having been subjected for some time to the rough conditions of train service. Unless the tests convey this information to railroad companies, to railroad commissioners and to the public, they had better not be made. Very few among the multitude of continuous brake inventors who have had the opportunity of equipping a train with their brake, have failed to make a good showing for their apparatus when every thing was in good order and experts were present to watch the device; but very many exceedingly promising brakes have failed utterly when subjected to the crucial test of daily hard work. Every man who knows anything about practical mechanical business is aware that an apparatus may work well when all the parts are properly lubricated, free from gum or grit, and the fitting in perfect order, and yet be next to worthless for ordinary service. The failure of hundreds of promising railroad devices corroborates this truth to every man of experience who has watched the rise and fall of promising patented appliances—spark arresters, for instance. Valuable lessons in this line might have been learned by watching the car-coupler tests at Buffalo, where the committee of judges wisely decided that the question of durability was one of the most important issues of the trial. Whatever can be said in favor of durability being a recommendation for a car coupler or any other car attachment, can with equal or greater cogency be urged in favor of having a durable brake; and we therefore trust that the committee of the Master Car-Builders' Association, and the owners of continuous brakes for freight trains, will agree upon conditions of tests that will demonstrate the durability as well as the stopping efficiency of the brakes under trial.

THE HAZARDS OF FREIGHT TRAIN SERVICE.

Many labored attempts have been made to reach an approximately correct estimate of the number of railroad employés killed and injured in freight train service, and especially in the coupling of cars. Estimates of this kind are necessarily based upon imperfect and fragmentary data, and the results, whether given in round numbers or otherwise, have to be taken with a liberal margin of uncertainty. Whether the actual number of casualties be more or less, there can be no question as to the magnitude of the evil. This is so universally admitted, and has been so frequently dwelt upon by railroad journals, and whenever couplers, brakes, dead-blocks, and other safety appliances have been discussed at car-builders' meetings, that an imposing array of figures showing the number of trainmen killed and injured annually, attracts but little attention. It has become wearisome from repetition and should go without the saying. It has ceased to create the kind of sympathy that leads to energetic action, without which there can be no promptly applied remedy or substantial relief. It is one thing to depict in lurid colors the horrors of a slaughter the extent of which is increasing every year, and quite another thing to lay aside personal interests and preferences, and do something at once that will at least lessen the number of the victims. Men whose business and duty it is to co-operate in devising practical remedial measures, will to-day be melted with compassion for the sufferers, and to-morrow, when the decisive vote is to be taken upon recommending some particular safety device, as good as any one of a dozen or more rival devices, and perhaps better, these same men will work with all their might to prevent a decision unless it happens to harmonize with their own individual views. If they succeed in carrying their point, as is usually the case, the spasm of abstract sympathy is forgotten, and the killing and maiming go on without abatement another year.

Although this picture is not overdrawn, there is perhaps something to be said in extenuation of that kind of sympathy which hastens so slowly to embody itself in deeds. Freight train service is necessarily hazardous, as much so as going to war, and those who engage in it voluntarily take the risks. The protection afforded should, of course, be none the less for that, although there is a limit beyond which the only safeguards must be found in the exercise of care and prudence by the men themselves. The mechanical precautions against accidents can never be so complete, either in the matter of coupling or the liability to fall between the cars, as to protect men who are heedless about protecting themselves. No railroad manager or other officer requires men to take the chances of being crushed between cars or caught in frogs and run over in track yards, yet these chances are taken every day. There is, in fact, something alluring and attractive to many persons in the hazards incurred, and there are ready recruits to fill the places made vacant by the victims.

It is well known that on many roads men are required to use a forked stick in guiding coupling-links, under penalty of dismissal from service for non-compliance, and yet as a rule they prefer to use their hands and arms and take the double chance of getting hurt and being discharged. It is this reckless class more than any other that swells the estimated number of casualties, excites pathetic appeals for legislative interference, and renders useless, so far as this class is concerned, the best safety devices that can be provided.

That a great many railroad officials see the matter in this light is evident enough, and accounts for the indifference displayed in regard to the carrying out of certain recommendations of the Car-Builders' Association designed to make freight train service less dangerous. Some five or six years ago, the association definitely determined what should be the position of brake-shafts, steps, ladders, the width of running boards, etc., on box and stock cars, in order to afford the greatest protection to trainmen, and if the resulting benefit has not been all that was expected, it is probably not so much the fault of the men in not making proper use of the means provided; but is due rather to the failure of a large number of roads to give any heed to the action of the association by making the attachments on their cars conform to what has been recommended.

HEATING AND VENTILATION.

These twin topics were dismissed at the November meeting of the Master Car-Builders' Club, in New York, and the tenor of the discussion afforded pretty good evidence, not only that the theme was becoming a little threadbare, but that the various methods now in use for the heating and ventilating of passenger cars are about as good as the nature of the case will admit. The discussion, instead of taking a wider range, was confined to the comparative merits of four heaters, two of which are placed respectively inside the car so as to warm it independently of the others by means of hot air heated by the furnace, another provides hot water for the purpose from a heater in each car, and a fourth for heating the entire train with steam conveyed in a main pipe from the locomotive and tapped underneath each car. These several devices were represented at the meeting by their inventors or advocates, each setting forth the economy and effectiveness of his favorite plan and subjecting the others to a vigorous cross-examination, so that the discussion soon run into a sort of soarring match interspersed with unseemingly personalities.

The time will probably never come when any one system of heating or of ventilating will supplant all others in respect to safety, economy and other essentials, and this for the reason that the conditions of the case are very difficult to deal with in a satisfactory way. In a car with fifty or sixty people in it, the cubic space for each does not exceed the space contained in a box four feet square. This is a small area, and as the occupants are usually made up of all sorts of people, it no easy matter to warm and ventilate them all to their individual likings. Some have a feeble vitality, are delicate and sensitive, and shrink from blasts of cold air, no matter how fresh and pure it may be. Others are in robust health, with a superabundance of vital heat, and with physical sensibilities that are proof against a Minnesota blizzard. There is also an intermediate class who are opposed to extremes and want warmth and fresh air in moderation: and here and there are nervous, fussy, fanatical persons, who have got pure air on the brain, who sleep with their windows up in the coldest weather to harden their constitutions, and who fancy they are inhaling noxious gases and deadly effluvia with every breath they draw while in a nicely warmed car in cold weather. To complete the diversity, an inventor may be on board who has just patented a pet scheme of his own for heating or ventilating, or both, and which is altogether superior in his estimation to any other plan yet devised.

In view of all this, and the fact that there is no very loud chorus of complaint on the part of the traveling public, it must be admitted that as a rule our passenger cars are not badly ventilated nor insufficiently or excessively warmed, and that the amount of misery endured by travelers on this score is not in the aggregate very alarming. The general run of people care little about the elements of the atmosphere as shown by scientific analysis, nor whether carbonic acid is deadly or salubrious or goes up or down when exhaled from the lungs; but they insist upon being as comfortable as possible when they are traveling in cars. They also insist upon judging for themselves as to whether there is an unpleasant draft, or whether they are too warm or too cold. A dozen Spuyten Duyvil accidents would not

start a crusade against car stoves, much less lead to their general disuse. The public know there is a limit to the usefulness of almost everything, and that in a crashing telescoping collision live coals are apt to be spilled out from stoves and the car set on fire. Yet people are willing to take the chances rather than endure discomfort. A stove can be made effective for purposes of ventilation by being inclosed in a drum so the incoming air can be passed around it and warmed, and then conducted in flues along the car floor and distributed through openings along the side. The well known Spear stove is of this kind, and with the aid of the clear-story ventilators, keeps up an influx of fresh warm air to take the place of the escaping vitiated air, thus preventing the annoyance of direct drafts from the outside. The end clear-story ventilators that have been so long in vogue, are a bad arrangement and hould be dispensed with. A much better plan is to have openings over the end windows, with slats to deflect the current upwards as it comes in, and with a register to regulate the volume as may be needed.

No system of heating or ventilating can be in all respects self-regulating. Something must always depend upon the intelligence of the brakeman, and as this is not always infallible, he has to be guided by the feelings and whims of passengers to a great extent, and as these are far from being identical, the brakeman must be more or less a target for censure. As we have already said, our cars are pretty well protected by existing appliances against the accumulation of foul air We would not of course discourage improvements. Let us have all that are really such, and all that the companies can reasonably be expected to furnish.

The Construction of Locomotive Engines.

By the courtesy of Mr. James Forrest, Secretary of the Institution of Civil Engineers, we have received a copy of a paper bearing the above title, that was read by Mr. William Stroudley, locomotive superintendent of the London, Brighton & South Coast Railway at the last meeting of the Institute in London.

The paper describes very minutely the details of construction and the working of the locomotives designed by the author for the line he is connected with, and it is interspersed with scraps of engineering philosophy that are generally original, and show that Mr. Stroudley reposes the fullest confidence in his own judgment. The leading peculiarity of his passenger locomotives is, that he places two pairs of driving wheels in the front without any truck or small wheel to lead. A pair of small carrying wheels are placed behind the fire-box. The freight engines have six wheels coupled without any small wheels. We reproduce the principal parts of the paper.

There has been from the earliest history of the locomotive, says the author, a diversity of opinion as to the relative merits of outside as compared with inside cylindered engines, many advantages being peculiar to each system. The author has endeavored to combine the best points of the two, having had a long experience with both. He observed that the axle-boxes, brasses, horn-blocks, and side rods of the outside cylinder engine would endure at least twice as long as those of an equally well-made inside cylinder engine. This he accounted for by the fact that whereas in the former all the rods and strains were in accord, those of the latter were in opposition. He therefore placed the outside crank-pin on the same side of the axle as the inside crank; the result as to durability being superior to that obtained in an ou side cylinder engine, by reason that the strain is divided between the frames, while the latter has a considerable overhang, which increases the load upon the axle-box above that given by the piston. When the cylinders are between the frames, a better distribution of the weight can be obtained. By placing the coupled wheels forward where the greatest weight is, the hinder part of the engine may have small wheels, the base be shortened and the use of heavy cast iron weights at the back of the engine be dispensed with. It is found that an engine runs much more smoothly when the center of gravity is kept well forward. The large leading wheels pass over the points, crossings, etc., very easily, causing much less disturbance than small ones. They pass round curves without shock or oscillation, which is no doubt owing to the small weight upon the trailing wheels, as it is the trailing wheels that have the most influence in forcing the leading flanges up to the outside curve. The author has adopted a somewhat high centre of gravity, believing that it makes the engine travel easier upon the road and more safely at high speeds; the slight rolling motion caused by the irregularities of the road having a much less disturbing influence than the violent lateral oscillation peculiar to engines with a low center of gravity. The high center of gravity also throws the greatest weight upon the outside or guiding wheel when passing round curves; and this relieves the inner wheels, and enables them to slip easily to account for the difference in the length of rail to be passed over.

The crank axle is the only disadvantage to an inside cylinder engine with an inside frame, and when this is of good proportions it offers but a small objection. Owing, however, to the narrow gauge of rails, the crank axle can not be made as strong as it ought to be, or there would remain no reason why a crank axle should break at all. When the flanges of the driving wheels are turned down thin, so as to avoid the side shocks given by crossings and check rails, there only remains the strain of the steam upon the pistons to cause breakage. * * *

As the crank axle cannot be made of the proper strength, it is well to avoid as far as possible risk of accident by its failure. By making the axle boxes and horn-blocks very deep and strong, giving large, flat surfaces against the boss of the wheel and the outside of the crank-arm, the driving wheel is kept in position after the axle is broken, if in the usual place, viz., through the inside hub near the crank pin or through the center part where it joins the inside web. An axle broken in this manner will run safely over any part of the road except at a through crossing, where the guiding rail is lost and the flange is liable to take the wrong side of the next point.

It has been pretty generally assumed that the driving axle of outside cylinder engines is not liable to break. This is, however, a mistake. They do break, although not so often as the crank axle. The piston, being attached to each end of the axle, causes violent strains from torsion, as the piston on one side pulls and turns its wheel; the axle then twists until its resistance to torsion turns the wheel upon the other side of the engine, and this occurs four times in each revolution; the momentum of the one wheel meeting the *vis inertia* of the other, and the axle having to bear all this in addition to its other duties. The author has known straight axles of steel, 7 inches diameter, to break in engines having 17-inch cylinders, and from the appearance of the fracture all these axles broke from torsion. Iron axles work loose like a bundle of sticks; the engine boxing, as it is called, by the alternate effort given off by the driving wheels. There is no doubt but that this ultimate twisting of the axle was what puzzled the earlier engineers in their efforts at balancing outside cylinder engines.

The whole of these engines have been so arranged that a part of the exhaust steam may be turned into the tanks to heat the feed-water. This is especially advantageous in a tank engine, by increasing the total quantity of water; it also keeps the water supply of greater purity and relieves the boiler of a certain amount of duty in heating the feed-water from the ordinary temperature. Hot feed water necessitates the use of a pump, as the author does not know of an injector that will deal with water of a temperature much more than 100° Fahr. It was, therefore, decided to turn special attention to the feed pump, and a very large valve area has been provided. A great many precautions are taken to prevent failures with the pumps, and their construction is rather complex. But the author says the pumps are no more trouble to repair than injectors, and that they require less attention.

The proportion of the valve gear adopted gives an admission of 78 per cent. of steam in full gear, which can be reduced to 12 per cent. with excellent results; and as at high speed the steam is never exhausted, the temperature of the cylinder is maintained and as much steam is locked up in the cylinders as raises the pressure at the end of the stroke to near that of the steam chest. This makes the engine run very smoothly at high speeds, and turns what would otherwise be an extravagant coal burner into an economical machine.

It is owing to this fact that the compounding of fast passenger or frequent stopping locomotives is not likely to show much if any economy over a well-designed simple locomotive. The case is different, however, in heavy goods engines working with a late cut-off. The back pressure observed in the diagrams of high-speed locomotives is not, therefore, a defect, but an advantage, and for this reason the author uses small steam ports and small travel of slide valve.

After describing the construction of the engines at considerable length, the paper continues: Indicated diagrams taken by one of the Crosby Steam Gauge and Valve Co.'s indicators at various speeds, and under varying conditions of gradient, afford a very fair idea of the working capabilities of these engines, the economical value of which is best shown by quoting the consumption of fuel for the half year ending June 30, 1884, when the average consumption of the whole of the engines on the line stood at 29.74 pounds per engine-mile, including the coal used in raising steam.

Some doubt has been expressed as to the value of heating feed water by the exhaust steam. The author, therefore, had a number of trials made with the ordinary heating apparatus removed and water fed to the boiler by the feed pumps. It was clearly proved that the heated feed water makes a reduction in the consumption of fuel to the extent of 2¼ pounds per train-mile.

With a view to ascertain what was the amount of power required to haul a train from Brighton to London, a complete set of 49 diagrams were taken from the engine "Gladstone," working an express train of twenty-three vehicles, the total weight of train and engine being 335 tons 14 cwt. The quantity of coal consumed was 24.87 pounds per mile, exclusive of that used in raising steam.

The temperature of the escaping gases in the smoke-box was taken at frequent intervals, also the degree of vacuum in the fire-box and in the smoke-box, and the quantity of water used out of the tender. To this, however, has to be added the water condensed from the exhaust steam, which the author estimates at 20 per cent. This gives an evaporation of 12.95 pounds of water per pound of coal, and one pound of coal will convey one ton weight of the train 13¾ miles at an average speed of 43.38 miles an hour.

STROUDLEY'S LOCOMOTIVES.

Throughout his paper, Mr. Stroudley skillfully adapts his reasoning to make his prejudices appear sound mechanical doctrine. We believe that all arguments made in favor of placing cylinders inside the frames are founded on a mistaken basis. It is generally admitted that the inside connected locomotives wear out their working parts much more rapidly than outside cylinder engines do, so that a considerable portion of the power must be expended in grinding down the connections. The inside connected engine is more expensive to build, much harder to repair and more awkward to handle and keep in running trim than the outside cylinder engine. Besides, the working parts being beyond the sight of the engineman, defects that lead to breakage are not so liable to be discovered in time. And for what are all these important advantages sacrificed? To the supposition that an inside connected engine rides the steadier, a mere prejudice derived from the times when designers had not learned how to balance outside cylinder locomotives. From experience with both kind of engines, we are satisfied that a well made American locomotive will run as steady as anything Mr. Stroudley ever built, and will cost only about half the expense incurred by an inside cylinder engine for running repairs. It is true, as Mr. Stroudley says, that the driving axles of outside connected engines sometimes break; but designers can make them as strong as they desire to, and there is no structural necessity for putting in an axle so weak that they know it will break, as is the case with those who design large inside connected engines. And they do not need to thin down driving wheel flanges to try and make themselves believe that in running over switches or crossings the axle will receive no end blows. Considering the number of serious accidents that occur through the use of crank axles, it is surprising that they are not abandoned, but more surprising still to onlookers are the devious ways crank axle advocates take to deceive themselves.

Mr. Stroudley may succeed in using the exhaust steam of his locomotives to heat the feed water, but if he does so economically he is the first we know of who has done it, and the problem has recorded more failures than any other experiment we remember in locomotive engineering. His engines may evaporate 12.95 pounds of water to the pound of coal, and we have no doubt that he believes they do, but we doubt it. In experiments of the kind made to ascertain the evaporation of water, it is the easiest thing in the world to make mistakes. Mr. Stroudley will find very few railroad men disposed to use pumps instead of injectors for fast engines, and few engineers well versed respecting the action of steam are likely to follow him in adopting small steam ports to secure superior economy at high piston speed.

Locomotives with large driving wheels in front may run safely on a comparatively straight road like the London, Brighton & South Coast, but they certainly would not be safe nor durable on a road with sharp curves. We remember years ago that considerable trouble from cutting flanges was experienced on a crooked Scotch road, with engines of the Hawthorn build that had the wheels, which were much smaller, placed the same way as they are arranged in Mr. Stroudley's locomotives.

POWER BRAKES FOR FREIGHT TRAINS.

The progress of invention in devising more effective appliances to meet the increasing demands of railroad transportation, is forcibly illustrated in the efforts which have been made during the past few years to provide power brakes for freight trains. Nine years ago, the subject was first brought to the attention of the Car-Builders' Association, and a committee was appointed to report upon it. There were great misgivings, however, as to the practicability of such a brake in freight service, although it was then being applied very successfully to passenger trains. The majority of the association evidently regarded the application of such a brake to freight trains as a very good thing in theory, but too chimerical and visionary and encumbered with too many difficulties to be reduced to practice. The task imposed on the committee was looked upon as a very peculiar one, inasmuch as it required a report to be made upon something which had no existence in fact. At the next annual meeting, in 1877, a report was made which amounted to little more than an expression of opinion that such a brake was highly desirable, and that the inventive genius of the country must be depended upon to supply it. Reports of the same tenor were made every year until 1881, when the committee mentioned 36 power brakes that had come to its knowledge, but none of them had been sufficiently tested to justify a preference. New devices continued to increase both in number and effectiveness, until the committee on the subject, in its report at the meeting of the association last June, made specific mention of two leading devices representing the two types—air and compression brakes—in respect to the merits of which a choice must ultimately be made by the road companies.

Although the need of something better than hand-brakes for the handling of freight trains is becoming more urgent every day, the problem is of such a nature that its solution can not be hurried without risk of making mistakes. The seemingly tardy progress already made has been due to the fact that a host of new devices had to be invented and tested as to their capacity to meet existing requirements. As shown by Mr. Wm. P. Shinn, in his elaborate paper on the subject read before the American Society of Civil Engineers at its last meeting, the weight of freight trains has been doubled within the last twenty years, and the comparative momentum of trains has increased in a much larger proportion. This, in connection with the increased speed with which fast freight trains are now run, and the prospective increase in the speed of all freight trains as soon as an effective brake control can be provided, shows the inadequacy of the present hand-brake method and the necessity of dispensing with it as soon as possible. Mr. Shinn estimated that only about four per cent. of all the freight cars in the country are as yet equipped with power brakes. This is a small proportion, but it will do for a beginning. It must be borne in mind that the changed conditions of freight transportation in respect to the weight, speed and momentum of trains, have quite outgrown the hand-brake system, and so long and to the extent to which that system is retained, the advantages derived from the time saved in the making of quicker trips, and making the same number of cars do twice the work by running at a higher speed, are practically lost.

We shall not undertake to strike a balance, in respect to economy and effectiveness, between air and compression

brakes, the one being continuously connected from the engine and acting only on the cars included in the connection; the other acting upon each car equipped with the apparatus and independently of the other cars, both systems being equally under the control of the engineer. If the cost of equipment and maintenance is regarded as a paramount consideration, the preference must be given to the detached or compression system. When the idea of power brakes for freight trains was first broached, the initial cost of $25 a car was regarded as the maximum, and $15 per car as about as much as any road could afford to pay for a practical train brake to supercede the hand system. Now, however, the urgency of the need for such brakes has to a great extent overridden considerations of cost, and it will soon be a question whether a power brake by which the average freight train of the period can be perfectly controlled, is not cheap at almost any price. It may be said, moreover, that the actual cost of equipment and maintenance is not a proper gauge of the economy of power brakes unless all the advantages and savings incidental to their use are deducted, and this might possibly exceed the entire outlay for equipment and maintenance.

There are also many other things, aside from cost, which must be taken into account. What is wanted is a system of braking that will practically perform the same service in the running of freight trains that automatic air brakes now perform for passenger trains, and such a system may be put in operation one of these days when freight and passenger cars and the service they respectively perform shall become more nearly assimilated than they now are. For every passenger train car now on our roads (including mail and express cars) there are 35 freight cars, and these latter are not only diversified in their drawing gear and other details of construction to meet the requirements of local standards, but those belonging to any one road are so scattered upon other roads by interchanging, that a most thorough accounting system is necessary in order to trace them. This state of things is not favorable for the working of continuous brakes. Air brakes can, no doubt, be used very successfully in freight trains made up exclusively of cars equipped with the apparatus, or of a certain number that can be kept together in running; but to render the automatic attachments of use when trains break in two, all the cars must be connected with the brake and kept together. The detached or compression system, however, of which the American Brake Co.'s brake is a representative, operates only upon the cars in a train that are equipped with it, no through connection being necessary. It may be said that in such case the draw-bars of cars equipped with it do the braking for all the cars in the train that are not so equipped, and that the roads owning such cars get their braking done for nothing. The only remedy for this inequality is to put the brake on all the cars of all the roads. As to the comparative cost of the two systems, as represented by the Westinghouse and American freight train brakes, the latter is just about one half that of the former. But the matter of first cost, although important, is not paramount, but must be weighed in the scale with the immense advantages to be derived from a brake system, whether actuated by air, compression, electricity, or other agency that is adequate to control heavy trains and dispense with the cumbrous and altogether inadequate hand-brakes now in use.

ILLITERATE TRAINMEN.

The safe operating of single-track railroads depends so much on trainmen being able to read and understand train orders, rules and operating instructions, that it might be supposed railroad companies would be extremely vigilant in ascertaining that men unable to read should not be employed in train service; yet there is reason to believe that this very important matter has on many roads received very little attention. Several important roads have lately introduced systematic examinations to test their trainmen for color blindness and visual defects, and a most unexpected development in connection with the examinations has been the number of men who could not read the letters painted on the test boards. In the West there have been very few men rejected for color blindness or other imperfections of vision, but on one trunk line about ten per cent. of the trainmen have been rejected as being unable to read. Among the men pulled off for this cause was an old passenger engineer reputed to be one of the best men on the road. Yet he had been running for many years on a single track without being able to read a word of the train orders he was in the habit of receiving daily. This, which may be regarded as a representative case, was very discreditable to the officers of the road, and equally so to the engineer's fellow employés. What can be more absurd than the practice of superintendents and other officers issuing books of instruction to trainmen, giving them orders in writing, and posting up notices for their guidance, and never finding out whether or not the men are competent to read a word of all the books, orders, and notices? A fine figure a railroad company would cut in a court of justice, were it demonstrated that a bad accident happened through a trainman not being able to read the orders issued for the safe moving of his train. A great many officers of worse managed roads are in the habit of sneering at the so called red tape of the Pennsylvania system, which is so exact about examining men and material; but this red tape is merely the outward evidence of orderly method which many other roads would do well to imitate. Thanks to their exact system, there is no fear of a Pennsylvania trainman causing an accident by being unable to read his orders.

It would be impossible for a man unable to read to rise in the service of any railroad company to the position of passenger engineer, without his fellow employés being conversant with his ignorance. These things are well known; yet a mistaken sense of class loyalty not only prevents men from reporting matters the officers ought to know, but this feeling in many cases induces them to use active measures to shield wrong-doing. By this means, men increase the danger of their calling through a mistaken sense of duty. Train operating on single lines is not free from danger when all possible precautions are carried out to prevent accidents, and the trainmen themselves are the most deeply interested in seeing that important rules do not become a dead letter. That a serious percentage of trainmen are unable to read the rules they work under, is disgraceful to the officers responsible for the hiring of the men, but the fellow-workmen are by no means blameless.

Indicator Practice and Steam Engine Economy.*

During the last few months we have perceived unmistakable evidences among leading railroad mechanical men of a revived or new interest in the indicator as a means of ascertaining what use locomotives are making of their steam, and we hail the appearance of the book bearing the above title as a most valuable and timely addition to the literature on this important subject. The author, Mr. Frank F. Hemenway, of the *American Machinist*, has in an eminent degree the experience and training that are necessary to produce a successful work of this kind. Mr. Hemenway is a self-made man, whose theoretical knowledge has been obtained by burning the midnight oil many an hour after finishing the daily work in the machine shop, and he knows from hard experience the points that need to be made particularly plain, so that men who have no instructor by their side may have no difficulty in understanding the principles of steam engineering enunciated. For practical information relating to his subject, Mr. Hemenway is able to draw from the stores of knowledge collected during years of experience as a builder of high-class steam engines, as an expert for years testing steam engines to determine the cause of disorders and suggest remedies, and latterly as editor of a mechanical paper, where he has been yearly made the councillor of hundreds of engineers who encountered troubles with their engines beyond their own comprehension.

The purpose of the book is succinctly stated in the preface by the author, who says: "It has been my aim to present the subject comprehensively enough to enable any engineer to apply the indicator to his engine, take the diagram, and make all necessary calculations from it. The endeavor has been to use no terms except such as are generally understood or fully explained, and no mathematical demonstrations are given or are required that involve the use of anything but simple arithmetical calculations. As one of the most important ends of the indicator can serve is to point out how to bring about economy of steam consumption, its use has been considered in connection with steam engine economy: there seems to be no rational way of dividing these subjects, even if it were desirable."

These words are seasonable and well worthy of attention, for a class of engineers has been growing up who learn to manipulate the indicator and speculate on the peculiarities of the diagram merely as a sort of mechanical accomplishment. Mechanical knowledge acquired in this spirit is about as valueless to the world as was the mathematical knowledge of certain schools of ancient philosophers, who scorned to degrade science by applying it to promote useful arts. In too many instances the indicator remains a mere plaything in the hands of users, because their knowledge of steam and its laws is too limited to enable them to comprehend the teaching of the diagram. For those who are seeking the knowledge that will enable them to make the indicator improve the steam engine, the work under notice will prove of inestimable value as a guide and helper. It will not tell an engineer why his engine is using twice the steam that ought to do the work performed, but it will put him in the way of finding out.

The first six chapters are devoted to describing the indicator as an instrument, explaining how to manipulate it, and how to read the diagram. The directions are exceedingly clear, and instruction is imparted in the spirit that everything worth doing is worth doing well. There are nineteen chapters in all, treating of steam engineering under such heads as, heat; the expansion of steam; measuring from the diagram the steam exhausted; initial expansion; small steam pipes; detecting leaky valves; steam engine economy; testing boilers and engines.

A long chapter is devoted to Diagrams from Locomotive Engines. A wood-cut is given showing a good way of connecting the indicator to a locomotive, and also a lucid description of the attachments, with directions how to apply and use them. Numerous full diagrams are given, taken from locomotives at all sorts of speed from 60 miles downward and doing all kinds of service. The most striking features of the various cards are explained and suggestive deductions made. For an engineer who has spent a great many years working on automatic engines, Mr. Hemenway is quite an exceptionally firm believer in the high value of the link motion. He gives considerable space to comparing the economy of the link motion with other forms of cut-off. A diagram is given taken from a locomotive with cylinders 16 × 22 inches, at a speed of 248 revolutions, or piston speed of 909 feet per minute. A hypothetical diagram that would be accounted very good for an automatic engine is plotted over the real one in dotted lines. Calculations of the two diagrams are very interesting, in view of the fact that the link as a means of working steam expansively is usually held to be responsible for a loss of from 25 to 40 per cent. They indicate that about 20 pounds of steam per hour would be used by the link and 17 pounds by the hypothetical diagram. "This," says the author, "would not be all gain, as the somewhat extremes of temperature in the cylinder in the instance of the hypothetical diagram would result in correspondingly greater condensation, and hence loss."

"It is customary with those who condemned the link motion to stop here and charge all this loss of efficiency to it. As a matter of fact, the link is responsible for only a small part of it. To appreciate this, it is only necessary to look at another condition that, equally with the link motion, influences the steam distribution, viz., the dimensions of ports. In this case the steam ports are 1¼ × 14 inches in area, between $\frac{1}{11}$th and $\frac{1}{12}$th that of the piston. In the best stationary engine practice, with which it is customary to compare the link motion, this proportion would not be accepted for a piston speed much greater than one-half that at which the diagram was taken, and to produce a diagram equal to the one sketched for comparison from a modern automatic cut-off stationary engine, the area of ports would need to be nearly double what it is in this case. If the area of the ports is increased as indicated, and the link motion used, the most of the difference against it will disappear."

Our limited space prevents us from dipping so deeply into the book as we would like to do. We know the book is one of the most interesting works on steam engineering that we have ever read; and we believe it to be one of the most valuable and instructive. Every page is replete with well-digested information. We very cordially recommend the work to every man interested in those problems of steam engine economy that the indicator helps to solve.

* Indicator Practice and Steam Engine Economy, with plain directions for attaching the indicator, taking diagrams, computing the horse-power, drawing the theoretical curve, calculating steam consumption, determining economy, locating derangement of valves and making all desired deductions; also tables required in making the necessary computations, and an outline of current practice in testing steam engines and boilers. By Frank F. Hemenway, associate editor *American Machinist*, member of American Society of Mechanical Engineers, etc. Fully illustrated. New York: John Wiley & Sons. Price ——.

Master Car-Builders' Standards.

We recently received a letter from an official closely identified with car building matters, asking what was the master car-builders' test for car axles. The Master Car-Builders' Association have not established any test for axles, but on talking round among railroad men and parties interested in railroad equipment, we discovered that a great many men were under the impression that the M. C. B. standards covered nearly all parts of an ordinary freight car. The prevailing ignorance on this subject was well illustrated at the car coupler tests at Buffalo, when the committee in charge prescribed that the standard link should be used; and no one present seemed to be aware that there was no such thing as a standard link in the sense it was understood. The parts of cars that the Master Car-Builders' Association have adopted standards for, are very easily enumerated, and the result of this year's letter ballots justifies the fear that the list is not likely to increase very rapidly. There is a standard axle, journal-box, journal bearing, pedestal and dead-blocks. In addition to these the association adopted a chill-mold for car wheels, a standard distance between flanges of wheels, a standard height of draw-bar, some dimensions for and attachments of draw-bar, a method of centering wheels when they are to be bored, a capacity of draw springs, and recommended the use of check-chains. For the protection of trainmen they made recommendations regarding the position of brake-shafts, the particulars of brake-steps or platforms, and fastening of brake ratchet wheel and pawl, running boards, steps, ladders and handles. They also adopted the United States standard screw-threads, besides several gauges calculated to promote accuracy in measurements.

We are glad to announce that Mr. George W. Morris, General Manager of The A. French Spring Co., Pittsburgh, Pa., has entirely recovered from the prolonged attack of illness under which he has been suffering for several months. Mr. Morris has long been identified with the company, and is widely known in railroad business circles. His numerous friends will rejoice to hear of his restoration to health, and that he is now able to attend to business as usual.

Miscellaneous Items.

THE United States Rolling Stock Co. are building 100 coal cars for G. P. Rend, Chicago, Ill.

THE Harrisburg Car Co. have received an order from the Delaware & Hudson Railroad Co. for 250 freight cars.

THE Ohio Falls Car Works, at Jeffersonville, Ind., have recently bought 1,000 tons of pig iron in expectation of an early resumption of work.

THE Minnesota & Northwestern Railroad Co. have ordered 20 locomotives and 1,016 freight cars to be built during the ensuing year.

MR. H. R. PARROTT, of the Parrott Varnish Co., Bridgeport, Conn., has been elected President of the New York & Connecticut Air Line Railway Co.

THE Brunswick & Western road has decided upon the permanent location of its shops at Brunswick, Ga., at which place a site has been donated to the company.

THE Bass Foundry & Machine Works, of Fort Wayne, Ind., make a cast-iron whistle for locomotives, which costs but $3, and gives good satisfaction.

MR. MOSES LYMAN, of Waverly, N. Y., has been appointed sales agent at Cincinnati by the Shelby Iron Company. Mr. Lyman was for years Treasurer of the Cayuta Wheel and Foundry Co., of Waverly.

THE Chicago, Milwaukee & St. Louis has just contracted with the Indianapolis Car Works for the construction of 500 box cars. They are to be 34 feet long, have a carrying capacity of 40,000 pounds, and to be first-class in every respect.

MEN of long experience in running fast trains say that one of the most difficult trains to make time with in this country is run from Denver to Pueblo on the Denver & Rio Grande Railway. The distance is 120 miles, which is made in 4½ hours, six stops being made on the way.

THE Union Pacific Railway Company are putting axles with collarless journals under all their passenger car equipment. Several other important railroad companies are following the same practice, so that it looks now as if the collarless journal would soon be standard on passenger cars. There is no doubt that it runs with less friction than the old style.

THE Chicago, Alton & St. Louis Railroad Company use a cast-iron wheel with steel tire for their engine truck and many tender trucks. About 1½ inch of the inside rim of the wheel is turned down ½ inch. A projection is rolled on the inside of the tire to fit this depression. The tire is shrunk on and the projection acts as a retaining ring to keep the tire on should it become loose.

THE North Chicago Street Railway Company are getting out plans for a new car shop that will be 150 × 106 feet, two stories high, and capable of storing 40 cars, besides carrying on extensive repairs. Mr. Augustine W. Wright, the very able chief engineer, does not favor the practice of street car companies building their own cars, but he believes in providing the very best facilities for doing repairs. When these shops are completed, they will contain over a mile of heating pipes.

THE Chicago, Burlington & Quincy Railroad Company have given notice to their employés working in the neighborhood of Chicago, and who have been carried to and from their work free, that after this time men newly employed will have to pay their fare the same as other passengers, and, at the expiration of two years, all employés will be prevented from riding free. The notice is not well received by the men affected.

MR. G. W. ETTENGER, who has recently been promoted to the position of Master Mechanic of the Chesapeake & Ohio Railway, has been for several years chief draftsman for the Superintendent of Motive Power, Mr. T. L. Chapman. Mr. Ettenger is a very able young mechanical engineer, and we are gratified to hear of his promotion, and think it presages good for the mechanical departments of railroads to see such men coming to the front.

A NEW kind of sleeping car has recently been added to the rolling stock of the Atchison, Topeka & Santa Fe road It is called the excursion sleeper, and is run on all express trains. It is not so elegant as the Pullman, but is a big improvement on the ordinary sleeper. There are fourteen sections in each car, and each berth is furnished with a comfortable mattress. Each section is divided with heavy curtains, the same as in Pullman cars. These cars are free to all emigrant passengers, who are required only to furnish whatever additional bedding they desire beside the mattress. At each end of the car are placed stoves for cooking and heating purposes. There are also complete lavatories in each car. The cars are kept clean, and the use of tobacco in any form is strictly forbidden.

WHILE the crew belonging to a switching engine in the St. Augustine yard of the Jacksonville, Halifax River & St. Augustine Railroad were temporarily absent from their post, the bad boy of the district happened to discover the unattended engine. He climbed up into the cab, got the throttle open, and before any of the railroad hands could catch on, engine and youngster were making for the woods. As there was no engine round to pursue the fugitives, the boy, who was thirteen years old, held the fort. He ran the engine till the water in the boiler was exhausted. The hot boiler sheets then set fire to the boiler lagging and cab, and all the wood-work about the locomotive was burned up. The engine was pretty much of a wreck inside and outside when the railroad men found her.

Long Stroke Locomotives.

Mr. George Hackney, Superintendent of Machinery of the Atchison, Topeka & Santa Fe Railroad, has four eight-wheel locomotives with 28 inches stroke running on passenger service and making 185 miles every day of the week. Mr. Hackney considers the engines are very successful. The cylinders are 18x28, transmitting power to drivers 69 inches diameter. With a mean effective pressure of 100 pounds in the cylinders, this gives a power of 13,147 pounds to turn the drivers. The valves have 5½ inches travel, have ¼ in. outside lap, and the cylinder steam ports are 17x1 1/16 inches, and exhaust port 2¼ inches wide The smallest ring of boiler is 50 inches diameter, the fire box is 72x33 inches, and there are 165 flues 2 inches diameter. The engines are worked with 3-inch double nozzles. The total wheel base is 23 feet 8 inches.

An Alloy of Copper and Lead.

No. 2,040 North Tenth street,
PHILADELPHIA, Dec. 8, 1885.

To the Editors of the National Car-Builder:

SIR: We are in receipt of a number of inquiries concerning the alloying of lead with copper, and desire to say, to whom it may concern, that we are masters of the situation in this respect, and shall take pleasure in showing the composition put together, or prove same by analysis. Our claim is, that we can alloy lead with copper, from 1 to 50 per cent., if desired.

THE AJAX METAL CO.

THE CUMMER ENGINE CO., Cleveland, O., have received orders for a 250 h. p. engine, steam jacketed, for the Nonatum Worsted Co., Newtown, Mass.; a 90 h. p. engine, also steam jacketed, for the Somersworth Mfg. Co., Dover, N. H.; and a 160 h. p. condensing engine for Cowdon Bros. & Hoppe, Hanna, Ind. The company also have under way a 415 h. p. engine for the Manchester Print Works, Manchester, N. H. Among their recent shipments are a 95 h. p. engine to the Price Baking Powder Co, Chicago; one of 55 h. p. to W. F. Frazier & Co., Aurora, Ill.; a 170 h. p. engine with boilers and outfit complete, to the Harney Peak Mining Co., Black Hills, Dak.; one of 90 h. p. to Frank Baer, Greensburg, Pa.; and a 67 h. p. engine to the Sikes Chair Co., Buffalo, N. Y.

THE Palmer Torpedo Railway Signal Co., of New York, whose signaling device was illustrated in our last issue, have received an order for seventeen of their machines from the Manhattan Elevated Railway Co., of New York.

MR. LEHMAN B. HOIT, formerly representative of the Cliff & Righter Co., spring manufacturers, Oswego, N. Y., assumed on the first of January the position of general manager of the Economic Motor Co. of New York City, with office at No. 9 Cortlandt street.

THE Union Brass Manufacturing Company, of Chicago, are very busy in filling numerous orders. They have sold 440 Hartley reclining chairs to the Missouri Pacific Railway Co., 34 to the Chicago & Alton, and 80 to the Pullman Palace Car Co. The Union Brass Manufacturing Co. are the sole manufacturers of these chairs.

MESSRS. PEDRICK & AYER, proprietors of the L. B. Flanders Machine Works, Philadelphia, have just issued a new illustrated catalogue of their special tools for railway repair shops, including a number of new tools of this class, which are specially entitled to the attention of those in charge of such shops.

THE Phœnix Wire and Iron Works are a new company formed to carry on the business of the E. T. Barnum Wire and Iron Works, of Detroit, recently destroyed by fire, until their legal complications are settled and a reorganization effected. They announce that they are now ready for business.

West Shore Railroad, N. Y. Central & Hudson River R. R. Co., Lessee.

ACCOUNTING DEPARTMENT,
280 Broadway, New York, December 6th, 1885.

Notice is hereby given that the railway formerly known as the "New York, West Shore & Buffalo Railway" has been leased from the "West Shore Railroad Company," and will be operated from this date as the "WEST SHORE RAILROAD, N. Y. C. & H. R. R. R. Co., Lessee."

Foreign lines are respectfully requested to divide their car service and ticket accounts and report as follows:

From December 1st to 5th, inclusive, to "Receivers New York, West Shore & Buffalo Railway," and from 6th to 31st inclusive, and thereafter, to the "WEST SHORE RAILROAD, N. Y. C. & H. R. R. R. Co., Lessee."

Service, material, shop and other accounts against Receivers New York, West Shore & Buffalo Railway end, as of December 5th, and bills for such should be rendered to that date.

The Receivership having terminated December 5th, it is specially requested that all accounts of every nature to that date will be rendered as early as practicable, with a view of closing them without delay.

Reports, etc., should be rendered to the undersigned.

To further facilitate settlement of accounts of the Receivers New York, West Shore & Buffalo Railway, as soon as it can be done, foreign lines are requested to send to this office a statement of account, in full, to December 5th, embracing ticket, car service and miscellaneous accounts.

All remittances to be made on account of the New York, West Shore & Buffalo Railway Company, and the Receivers New York, West Shore Railway, and for all other accounts relating to business before or after December 6th, 1885, should be sent to E. W. Rossiter, Treasurer, Grand Central Depot, New York, and care should be taken to state the account on which remitted.

J. W. REINHART,
General Auditor.

[CIRCULAR LETTER NO. 1.]

The Standard Equipment Company.

MUTUAL LIFE BUILDING,
32 Nassau Street, New York, Dec. 1, 1885.

GENTLEMEN: Because of large investments and close competition in railroad business, the minimum cost for service and management is demanded.

To meet such demand, in some degree, the Standard Equipment Company has been organized, and is under the control of Wm. Windom, of Minnesota; Thomas L. James, of New York; Wm. H. Barnum and Morris W. Seymour, of Connecticut. John H. Rice, David B. Barnum, Chas. E. Hubbell, Geo. B. Hibbard and P. B. McLennan, of New York, constituting its board of trustees.

This company has acquired the sole and exclusive right to sell and lease to railroad companies in North America, the Eames Vacuum Brake, for use on freight trains, and is now prepared to contract for the equipment of freight locomotives, tenders and cars therewith, and to maintain and guarantee the same, for a term of years, in perfect efficiency and condition, at rates of rental which will save to the lessees more than 75 per centum of the average cost of hand braking.

This company asserts that the Eames vacuum brake is the only power brake in existence which operates with absolute simplicity, efficiency, safety and certainty, unaffected by the heats of summer, the frosts of winter or other conditions, and with economy reduced to the minimum. It challenges trial and competition with any other power brake for freight service, without expense to the railroad company inviting the contest.

The Eames vacuum brakes are now in successful and satisfactory use upon more than one hundred and seventy-five (175) railroads, including the elevated roads in this city, trains upon which average more than 70,000 stops per day, and where no other system of braking is practicable and safe.

Railroad managers, engineers and stock-holders are respectfully invited to investigate the subject matter of this letter.

GEO. B. HIBBARD, General Manager.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any errors that may be noticed in our list:

Atlantic & Pacific.—I. G. McCuen, Superintendent of Machinery of this road, died suddenly, Nov. 19, of heart disease, at Albuquerque, N. M.

Central Iowa.—E. L. Dudley, who has for some time been Superintendent, has been appointed General Manager.

Chesapeake & Ohio.—C. W. Smith having resigned, the office of General Manager is abolished. G. W. Ettenger has been appointed Master Mechanic of the Richmond shops, vice C. F. Thomas, resigned.

Cincinnati, Hamilton & Dayton.—Charles Neilson has been appointed General Superintendent.

Delaware & Hudson Canal Co.—C. E. Rettew has been appointed Master Mechanic, in place of S. H. Dotterer, deceased.

Florida Railway & Navigation Co.—L. G. Randolph has been appointed Master Mechanic, vice R. V. Dohoney.

Georgia.—L. A. Hemphill, heretofore Master of Transportation, has been appointed Superintendent.

Hanover Junction, Hanover & Gettysburg.—Chas. G. Herman has been appointed Master Mechanic, in place of J. J. Bingley, resigned.

Illinois Central.—E. T. Jeffrey, who has heretofore been General Superintendent, has been appointed General Manager. Mr. C. A. Beck, Superintendent of the Illinois and Iowa Divisions, succeeds Mr. Jeffrey as General Superintendent; and Mr. T. J. Hudson succeeds Mr. Beck.

Jacksonville, Tampa & Key West.—A. Hendee has been appointed Master Mechanic, vice C. J. Richards, resigned. Mr. Hendee was formerly on the Mexican Central, and more recently on the Columbus & Cincinnati Midland.

Mineral Range.—John Shields has been appointed Master Mechanic, in place of T. I. Shellhorn.

Missouri Pacific.—Abraham Gould has been appointed Purchasing Agent.

New York, Lake Erie & Western.—R. H. Soule has been appointed Superintendent of Motive Power, in place of F. M. Wilder, resigned. Mr. Soule has for several years held a similar position on the West Shore road.

Ohio & Mississippi.—C. C. F. Bent has been appointed Superintendent. He was recently Superintendent of the Louisville, New Albany & Chicago.

Ogdensburg & Lake Champlain.—E. J. Chamberlin is Acting Superintendent in place of A. A. Gaddis, General Manager.

Panama.—F. G. Ward has been appointed General Superintendent, in place of G. A. Rust, resigned.

Pittsburgh, Cincinnati & St. Louis.—Frank G. Darlington has been appointed Superintendent of the Cincinnati & Muskingum Valley Division, vice W. F. Black.

Port Royal & Augusta.—John W. Green has been appointed General Manager. He is also general manager of the Georgia R. R.

Texas & St. Louis.—W. J. Lewis, heretofore Master Mechanic of the Texas Division, has been appointed General Master Mechanic of the entire road.

Union Pacific.—Clement Hackney has been appointed Superintendent of Motive Power, in place of I. H. Congdon, resigned. Mr. Hackney has been for some time on the Atchison, Topeka & Santa Fe.

Washington, Ohio & Western.—Robert Bell has been appointed Superintendent.

Employment.

WANTED.—By a first-class draftsman and practical car-builder, a situation in a railroad car-shop, as draftsman or in some other capacity. The advertiser is well acquainted with the construction of sleeping cars, ordinary coaches and other cars; has had long experience, and can furnish the best recommendations. Is a married man. Address F. H. G., office of the NATIONAL CAR-BUILDER.

How natural it is to try to get *something* for *nothing*, and expect satisfaction in the use of materials that look well but have no real merit. This is exemplified in painting cars as much as anywhere. The Perfect Method Paints manufactured by us insure durability and saving of time otherwise lost in repainting, or loss by decay of the wood and rust of the iron when the paint has perished, as most of the ordinary paint soon does.

THE SHERWIN-WILLIAMS CO.,

CLEVELAND & CHICAGO.

Manuf'rs High Grade Paints and Colors for Railway use.

Established 1856.

Shipman & Bolen, Mfrs. of fine

Railway Varnishes.

Our Varnishes excel in durability,

Newark, New Jersey.

HARTMAN STEEL CO.

(LIMITED).

BEAVER FALLS, PA.

NAIL TRADE FOR MARK NAIL

Our Steel Wire Nails, both Barbed and Smooth, practically cost no more than the old-fashioned cut nails.

JAMES T. PATTEN,

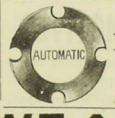
RAILWAY EQUIPMENT.

REPRESENTING THE

Wason Mfg. Co., of Springfield, Mass. RAILWAY CARS, ETC.

Portland Company, of Portland, Me. LOCOMOTIVES.

18 BROADWAY (Welles Building), NEW YORK.



AUTOMATIC NUT LOCK.

For Holding a Nut Firmly Against Wood or Iron.

Samples sent to any address.

AUTOMATIC NUT LOCK CO., Waterbury, Conn.

FINEST QUALITY FIRE BOX AND BOILER PLATES

By the Crucible and Open-Hearth Processes.

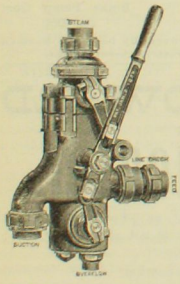
HUSSEY, HOWE & CO. [Limited],

PITTSBURGH, PA.

(The Oldest Manufacturers of Crucible Fire-Box Plates.)

BEST QUALITY TOOL STEEL AND Standard Crucible Spring Steel.

Made Expressly for Railroad Use.



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THE "NEW IMPROVED"

HANCOCK LOCOMOTIVE INSPIRATOR.

Awarded the FIRST PRIZE—A GOLD MEDAL—at New Orleans Exposition, 1885.

The Most Perfect Locomotive Boiler Feed,
Most Durable,
Most Economical,
Most Convenient.

Send for Descriptive Circulars to

THE HANCOCK INSPIRATOR CO.,

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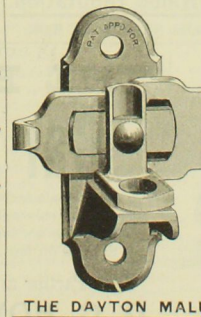
"THE DAYTON" CAR DOOR FASTENER.



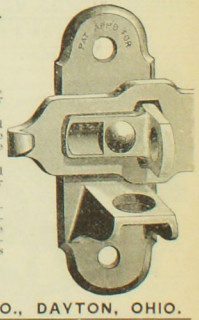
POINTS OF SUPERIORITY.

1st. It has no loose parts, or chains, to be broken or lost.

2d. It is very strong and perfectly simple, and the cheapest Fastener in the market.

3d. It can be sealed with wire or tin seal, or locked with padlock.

4th. It has double slotted hasp, so that, if desired, the door can be locked, open for ventilation. Single slotted hasps furnished if preferred.



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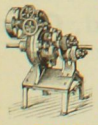
THE DAYTON MALLEABLE IRON CO., DAYTON, OHIO.



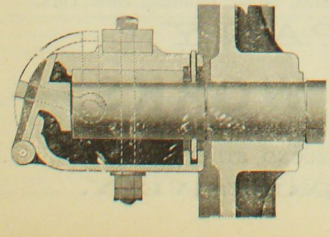
Otto's Patent Flue-Cleaning Machine

Will take off the thickest crust of lime by passing once through. Noiseless, self-feeding, adjustable and reversible, and needs no counter-shaft. Occupies but little room.

Circulars, with full description, on application.

L. B. FLANDERS MACHINE WORKS,

PEDRICK & AYER, Proprietors, 1025 Hamilton Street, Philadelphia, Pa.



RAOUL JOURNAL BOX.

This box is designed to provide an end stop for the axle, and thereby dispense with the shoulder and collar, and at the same time not obstruct the process of packing the box. The journal may be made any desired length and diameter. The life of the axle is doubled. The expense of brasses and lubricants enormously reduced, and wear of brasses and hot boxes obviated. It is now in successful operation on trucks of engines, tenders, passenger and freight cars. For further information address

RAMAPO WHEEL & FOUNDRY COMPANY, Ramapo, N. Y.;

Columbus Iron Works Company, Columbus, Ga.

Important to Railroad Managers and Master Mechanics.

SIBLEY'S PERFECTION VALVE OIL.

More perfect lubrication insured, and entire free from guaranteed from corrosion of cylinders and destruction of steam joints by fatty acids.

In exclusive use on 50 railroads.

References and prices furnished upon application.

☞ Make exclusive specialty of the Manufacture of Valve and Signal Oils for Railroad use.

SIGNAL OIL WORKS,

FRANKLIN, PA.

J. C. SIBLEY, President.

CAR SEATS.

GEORGE BUNTIN & CO.,

SOLE MANUFACTURERS OF

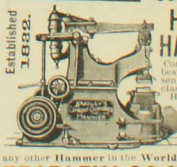
Buntin's Patent Car Seats,

AND NICKEL PLATED ARM CAPS, IN USE ON RAILROADS GENERALLY.

No. 1,042 Ridge Ave., Philadelphia.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.

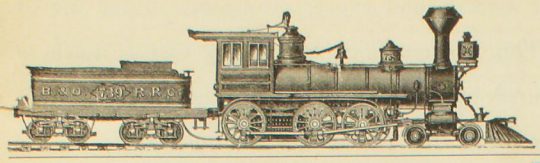


Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

BRADLEY & CO. Syracuse, N.Y.

PATENTS.

PROMPT WORK, MODERATE FEES, U. S. and Foreign procured. Trade Marks and Labels registered. 15 yrs. experience; 4 yrs. Examiner in U. S. Patent Office. Patent causes litigated. Expert searches and opinions as to scope, validity and infringement of patents. Send model or sketch of your invention for FREE opinion whether patent can be secured, and new book on patents citing recent court decisions. Mention this paper. E. B. STOCKING, Atty., opp. Patent Office, Washington, D. C.



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PITTSBURGH, PA.

MANUFACTURERS OF

Locomotive Engines for Broad or Narrow Gauge Roads,

From standard designs, or according to specifications, to suit purchasers.

Tanks, Locomotive or Stationary Boilers Furnished at Short Notice

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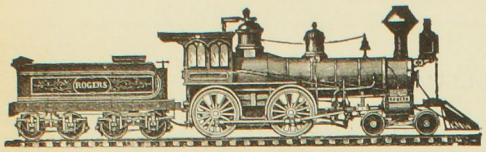

ROGERS LOCOMOTIVE AND MACHINE WORKS,

PATERSON, N. J.

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Manufacturers of Locomotive Engines and Tenders and other Railroad Machinery

J. S. ROGERS, President. R. S. HUGHES, Secretary. WM. S. HUDSON, Sup't. } PATERSON, N. J.

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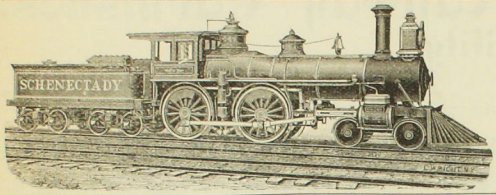

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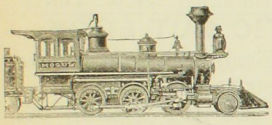

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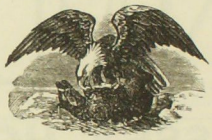

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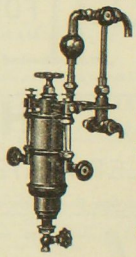

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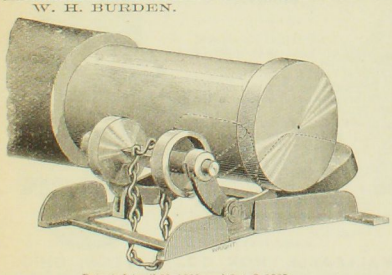

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